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A Study to Develop a Management Model for the Optimal Mix of Inpatient Services for Womack Army Community Hospital, Fort Bragg, North Carolina

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Utilizing the available knowledge of Womack Army Community Hospital inpatient costs and those of CHAMPUS, a management model was developed that minimized the overall government cost for selected DRGs in the Fort Bragg Catchment Area. The quantitative technique used was linear programming. Constraints focused on available bed days, physician staffing, nursing personnel staffing,and estimated demand for services. Resources and their consumption rates are qualified. The model provides management with a timely, flexible, and quanitative means of determining resource allocation.

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A STUDY TO DEVELOP
A MANAGEMENT MODEL FOR THE OPTIMAL MIX
OF INPATIENT SERVICES FOR
WOMACK ARMY COMMUNITY HOSPITAL

A Graduate Research Project

Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Health Administration

by

Major Patricia A. H. Saulsbery, ANC

July 1988

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Finally, to my family who will be glad to see the final phase of this Master's program completed. I extend my appreciation and admiration for their love and support through this sometimes difficult period.

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A STUDY TO DEVELOP A MANAGEMENT MODEL FOR THE OPTIMAL MIX OF INPATIENT SERVICES FOR WOMACK ARMY COMMUNITY HOSPITAL

INTRODUCTION

The challenge of providing health care in the face of rising costs and limited resources demands the attention of hospital administration. Military Treatment Facility (MTF) administrators and health care providers must be able to provide quality patient care in the most cost efficient manner. Inpatient care is provided through the MTF or through the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) for eligible beneficiaries. Recent changes mandated by Congress have placed additional emphasis on the management of CHAMPUS dollars. These two separate means of delivering inpatient services each have unique characteristics that will be discussed beginning with the military hospitals.

Currently, funding for the military medical treatment facilities is based on the Medical Care Composite Unit (MCCU) which is a equation summarizing admissions, live births, occupied bed days, and outpatient visits. This is collectively referred to as the hospital's overall Workload. As a disadvantage, the MCCU is insensitive to case mix and cannot be compared among hospitals. Public Law 99-661, dated 14 November 1986 directs that resource distribution for MTFs be based on DRG measures.

The implementation of Diagnosis Related Group (DRGs) will take place over a five year period beginning with Fiscal Year (FY) 1988. Of particular importance in the early phases of implementation will be the establishment of case mix profiles for use in establishing trends for each facility as well as calculating relative weights for the DRGs (Tri-Service Performance Measurement Working Group 1987, 1). (Case mix profiles have been calculated for MTFs for FY 85, 86, and are pending for 1987.)

Effective 1 October 1987, a Diagnosis Related Group payment system modeled on the Medicare Prospective Payment System (PPS) was established as a method of payment for CHAMPUS inpatient hospital care. It was instituted as a means of curtailing escalating CHAMPUS costs. (Federal Register 1987, 32992).

The implementation of DRGs by CHAMPUS and the phased introduction of DRGs for military hospitals offers a common means of comparison between the two systems. In evaluating these systems, military health care administrators can determine the military cost per selected DRG as well as the CHAMPUS cost for that DRG. The challenge, then, is to utilize this cost knowledge, in conjunction with hospital resources, to develop a management model for inpatient services that will minimize the overall cost to the government.

Conditions Which Prompted the Study

The Fort Bragg catchment area serves a population of 132,036 consisting of 45,699 active duty service members and their 52,102 family members. There are also 34,235 military retirees/ annuitants of all services and their family members who are eligible for care at Womack Army Community Hospital (WACH) (RAPS 1988). See Table A.

CHAMPUS expenditures for inpatient hospital services (total government cost) in the Fort Bragg, North Carolina area during the period Fiscal Year 1987 was in excess of fifteen million dollars. The patient's co-share cost alone exceeded three million dollars. CHAMPUS high volume and high cost areas included: Cardiology; Pulmonary/Respiratory; Obstetrics; Gynecology; Psychiatry; Special Pediatrics; and General Surgery (CHAMPUS Report No: HR085-007, 1-11-88 1988). These cost areas represent clinical specialties which WACH cannot provide because of limited personnel and other resource constraints.

These FY 87 CHAMPUS expenditures were based on reimbursement of billed charges, while FY 88 expenditures will be based on the CHAMPUS DRG system. In addition, the Department of Defense has had their FY 88 CHAMPUS funds allocated directly to the individual service level to improve accountability (CBO 1988). In resource management, the combination of these two factors provides an excellent opportunity for the military health care administrator to better manage the CHAMPUS costs within the established catchment area. One key cost management factor would be knowledge of the CHAMPUS payment per DRG within the local community compared to the actual cost of the same diagnosis for care rendered in the MTF.

In order to discuss CHAMPUS payment per DRG within the catchment area, some background information regarding Womack Army Community Hospital is necessary.

The Womack Army Community Hospital building was dedicated in 1958. The basic configuration of the building is representative of health care in the 1950s supplemented by a clinic wing added in 1974. Extensive electromechanical upgrades have been completed in the past seven years to bring the facility up to date. Womack is an acute care, general hospital with medical, surgical, obstetric, pediatric, and psychiatric care provided on both an inpatient and outpatient basis. Current actual operating bed capacity is 235 beds with an average occupancy of 195 patients, i.e., an occupancy rate of 83%. (Note that this is an adjusted figure from the 288 operating beds as listed in the <u>1987 AHA Guide to Health Care Field</u>. The areas of Pediatrics and Psychiatry have adjusted their acceptable bed capacities downward based on patient acuity.)

Hospital personnel and equipment levels are based on the Table of Distribution and Allowances (TDA), which reflects the current requirements and authorizations for personnel. Clinical personnel have been augmented through the Direct Health Care Provider Program and additional contract personnel in the form of physicians, nurses, and technicians.

The combination of an aging facility, limited health care resources, and a large beneficiary population has created a health care environment where demand exceeds available resources. CHAMPUS, the alternative source of care, is expensive for the government as well as for the patient who incurs a fee or copayment. The challenge for hospital administrators is to make the most effective use of existing resources within the given constraints and at the lowest possible overall cost to the government.

Statement of the Problem

To develop a management model for determining the optimal mix of Inpatient Services for Womack Army Community Hospital.

Objectives

The first objective of the research began with the determination of which inpatient services by DRG were to be used in the model. Those chosen were high cost and high volume DRGs for both Womack and CHAMPUS. In conjunction with the selection of the DRGs to be used, the case mix for Womack Army Community Hospital (WACH) for Fiscal Years 1985 and 1986 was determined.

The second objective dealt with the determination of costs. It was necessary to establish the average cost for Womack per selected DRG and to establish the average CHAMPUS cost per selected DRG for the Fayetteville, North Carolina area.

Development of constraints was the next objective. Development included determination of bed constraints for Womack clinical services in Medicine, Surgery, Pediatrics, Orthopedics, EENT (Ophthalmology and Otorhinolarynogology), and Obstetrics. Womack physician and nursing personnel staffing was also brought into the constraints. CHAMPUS demand and total demand for health care services were also primary considerations in development of constraints.

The final objective involved the formulation of the mathematical model that minimized the overall cost to the government for the provision of selected inpatient services at WACH. This culminated in the use of the model to make recommendations for management strategies in providing an optimal mix of inpatient services at Womack balanced by the CHAMPUS alternative.

Criteria

The criteria used to evaluate the mathematical model directed that the overall financial cost to the government for the provision of inpatient services must be minimized. Also, the model should permit changes in constraints as staffing and resource availability change.

The actual mathematical model formulation must contain a statement of the objective function which minimizes overall cost. Additional considerations in model formulation included the availability of alternative courses of action to adjust the workload within the given constraints, and the presence of resources limitations at Womack in terms of staffing and available facilities. Also, the standards for the resource constraints of personnel (physicians and nursing) could not be exceeded using this model because of the possibility of degradation of quality of care. Considerations for training requirements of the Family Practice Residency Program, Obstetric/Gynecology (OB-GYN) Nursing course, and the Patient Care Specialist (LPN) Course, must also be included in the constraints as determined by the program directors.

Assumptions

There were four assumptions made when performing this study. The first is that there is no excess capacity in the hospital for the addition of new services without changing the existing service mix. Second, there will be no substantial changes in the capabilities of Womack Army Community Hospital to provide inpatient services. The third assumption is that the Medical Expense and Performance Reporting System (MEPRS) for fixed medical and dental treatment facilities used to determine the average cost per diagnosis is accurate and fixed costs for the facility are proportionately distributed over the entire facility. Finally, the characteristics and needs of the population served did not vary greatly during the FY87 study period.

Limitations

There were six major limitations identified in this study. First, the derived model, using the costs for CHAMPUS and WACH, was applicable to only the Fort Bragg catchment area. Secondly, it was recognized that certain diagnosis will be cared for at WACH because of the patient's active duty status, regardless of the relative cost compared to that of CHAMPUS. Third, determination of the Womack cost per DRG was based on Clinical Service data. This data was collected per occupied bed day by clinical service rather than by specific diagnosis. In other words, a macro variable was used to determine cost where a micro variable would have been more appropriate. Until the implementation of DRGs and subsequent DRG interface with MEPRS at Womack, this will be the most accurate means of assigning costs to a specific diagnosis.

Fourth, the computer program utilized was limited by software programming which allowed only fifty variables and fifty constraints. Next, the study is limited by the inability to accurately assess the actual demand by the beneficiary population. Retirees and family members may be using other third party insurance coverage rather than dealing with the either

CHAMPUS or Womack. Finally, estimates of personnel staffing requirements were made by a combination of a jury of expert opinion, draft manpower standards, and actual assigned personnel.

LITERATURE REVIEW

Controlling Health Care Costs

During the 1960s, health care was focused on expanding the delivery of health care services. Federal legislation reinforced societal expectations that health care was a right with the passage of the Social Security Amendments of 1965, or Title XVIII and XIX, principally Medicare and Medicaid. There was little emphasis on cost control as hospital reimbursement was retrospective and based on the cost of providing care. This contributed to the rising spiral of health care costs in this country (Covaleski 1987, 137). Another factor was that the decision makers, or "gatekeepers", who determined the use of health care resources were the physicians and hospitals. Consequently, the federal government's payment responsibilities grew dramatically through the Medicare program. The cost of Medicare in 1967 was 4.6 billion dollars compared to 62.9 billion dollars in 1984 (Gunn 1987, 143, 150).

The growth in national health care expenditures during this time is evidenced in the changes from 1966 when expenditures were 6 percent of the Gross National Product (GNP), compared to 8.5

percent in 1976, and then 10.9% in 1986. The 1986 figures show that an average of $1,837 per person was spent on health care for a United States total of $458 billion (Griffith 1988, 136).

Under the cost-based reimbursement system, there was an incentive to increase costs that could be assigned to cost based payers such as Medicare or an incentive to set charges at a level that would also increase reimbursement. During the 1970s, it was recognized that health care expenditures were rapidly rising. Governmental controls focused on capital expenditure control and rate setting programs. Thus, reimbursements were set for the lower of cost or charges. These, however, did not prove effective in controlling rising costs (Gunn 1987, 151-153).

The Tax Equity and Fiscal Responsibility Act of 1982 (P.L. 94-248) (TEFRA) and P.L. 98-21, the Social Security Amendments of 1983, established the Medicare Prospective Payment System (PPS) for inpatient hospital services effective 1 October 1983. Medicare reimbursement, henceforth, would be based on a pre-established, specific rate for each Diagnosis Related Group rather than on the retrospective reasonable cost basis of the past (Levine and Abdellah 1984, 105-106).

The Diagnosis Related Groups (DRGs) were originally developed by researchers at Yale University for the purposes of utilization review and quality assurance. The use of DRGs has evolved from a clinical categorization tool to a system or model for measurement of resource consumption (Womack and Fleming 1986, 380). These diagnosis groupings were developed on actual hospital cost experience from elements that contributed to the consumption of resources during a patient's hospitalization. These elements included the patient's diagnosis, complications, age, and surgical procedures. The average cost per case was determined which, in turn, established the base price to be paid by the government for specific diagnostic categories. The diagnostic groupings were based on the various codes in the International Classification of Disease (Clinical Modification), 9th Revision (IDC-9-CM) which produced a homogeneous group of diagnostic codes as well as resource usage (Plomann 1982, 15).

The overall goal of the PPS was to improve productivity, efficiency, and effectiveness in the delivery of health care services. Enhanced productivity would, theoretically, decrease the cost per patient admission, while efficiency, (cost per procedure, patient day, or specific treatment) would increase. Effectiveness then, becomes the utilization and outcome of the procedures, treatments, and lengths of stay (Gray and Metwalli 1987, 31). The final outcome would be a decrease in the growth rate of Medicare expenditures and the provision of quality hospital care at the lowest cost.

Comparison of costs among hospitals is difficult according to Sheingold (1986, 8) who states that cost differences between hospitals will exist despite equal levels of efficiency because of variable labor markets and nonlabor inputs. These will result in different prices for goods and services. Hospital outputs will also vary based on the types of patients served, scope of services, available technology, and staffing requirements.

Case mix is the relative proportion of the different types of cases a hospital treats. It can be further defined as the intensity of resource consumption per admission or the costliness of providing care for that particular category of patient. Each DRG is assigned a weight which reflects the relative costs of that particular DRG category. The case mix index (CMI) for a hospital is calculated by summing the weighted discharges (based on a standardized relative weight) and dividing the total sum by the number of discharges. Based on the average of 1.0, a CMI of .75 would indicate that the hospital's patient population was 25 percent less costly or complex than the average of 1.0 (Finkler 1985, 28).

An often noted problem with the DRG system is that the severity of illness and subsequent cost variations are not reflected in the DRGs. This leads to case-mix compression whereby the costs of the more resource intensive DRG is diluted in relation to the less resource intensive diagnosis (Sheingold 1986, 9). Another problem that affects hospital costs is the number of hospital beds. This translates into the scope of services offered such as special care units or the availability of technology. Sheingold (1986, 60) points out that larger hospitals will often have newer equipment, technology, and specialty care units that will increase operating costs as well as attract the more resource intensive patient.

Recent studies involving the case-mix relationship to cost differences between teaching and non-teaching hospitals (Frick, Martin, and Schwartz, 1985, 283) noted that the case mix differences occurred in a small number of DRGs. Teaching hospitals had more surgical cases and neoplasms, while the non-teaching hospitals DRGs were focused on respiratory illnesses, circulatory and digestive disorders, and accidents. They further found that the difference in resource use rather than case mix differences accounted for the difference in average cost per case within specific DRGs. This may be a result of a more complex mix of patients from a severity of illness point of view to which the DRGs are not sensitive. It may also be a reflection of the treatment protocols to improve patient outcomes; or, it can be reflective of inefficiencies (Frick, Martin, and Schwartz 1985, 290).

Baptist and Bachman (1986, 1) suggest that hospital managers organize DRG data in two ways. The first would be a method of capturing patient charges, deductibles or coinsurance, and payments received. The second method focuses on case mix which would categorize patients by groups such as by DRGs, clinical service, physician groups, payer groups, and other product line groups. This method gives management the flexibility to analyze utilization, charges, cost, and profitability at an individual patient level as well as at a higher summary level.

Baptist and Bachman (1986,15) further note that reimbursement strategy development depends on two main ingredients. The first is an in-depth knowledge of all pertinent regulations combined with a mechanism of monitoring proposed regulations and actual changes. The second is to have the necessary support through information management systems and personnel to create and test new strategies in response to changes.

Management must be prepared for organizational changes such as decentralization of decision-making, an increase in management data collection, and increase in the importance of Medical or Patient Records (or Patient Administration Division). Physicians must also increase their role in the decision making process. Finally, emphasis should be placed on the output produced rather than just on cost input (May and Wasserman 1984, 553-54).

Womack and Fleming (1986, 381) suggest that implementation of DRGs in the military system could stimulate competition among DOD hospitals for the provision of efficient and effective care. However, the unique nature of the military hospital's readiness mission may require the continuation of some services that are not economically beneficial to the hospital. Competition within the hospital could also result in allocating resources to the most profitable services, which again may result in an inappropriate balance of local services. This could have an adverse effect on mobilization preparedness and mission requirements of units supported by the local MTF.

Womack and Fleming (1986, 381) further note that the use of DRGs can optimize the use of the federal health care dollar. This could be accomplished through competitive bidding in geographical areas and the use of DOD/VA sharing agreements. A long range strategic goal would be the coordination of a comprehensive planning system for health services within a given catchment area. The readiness mission of the hospital must not be sacrificed for simple economics.

A major force behind the PPS was the goal to slow the rise of health care expenditures. Providers control a good portion of the cost of health care as they admit patients and devise the treatment regimen which may consist of various medications, treatments, and therapeutic modalities. One fourth of hospital charges can be attributed to laboratory and radiological services. Thomas and Davis (1987, 183-184) conducted a study to measure the cost awareness of physicians after the introduction of the PPS and an aggressive educational program by the hospital management. Despite the administrative programs and the resource controlled environment, physicians showed little change in cost awareness as compared to studies prior to the PPS. Physicians cited that they lacked effective education, received little feedback, lacked knowledge of administrative policies, and received no financial incentives. Prior to this particular study and the PPS implementation, a broad educational program was instituted. This program included: presentations at medical staff meetings and departmental meetings; distributions of lab charges to physicians; maintenance of current supply price lists; and a rank order listing of physicians for their charges. As this study was performed during the early phases of the PPS implementation, it would be interesting to reevaluate now that the system has been in place for five years.

CHAMPUS DRG-Based Payment System

The Civilian Health and Medical Program of the Uniformed Services was initiated in 1966 as a primary health insurance for over six million family members and retirees. The intent of CHAMPUS was to supplement the health care services provided by the existing military medical care system. However, access to the military health care system has become increasingly limited because of declining resources and a rising beneficiary population (Kimble 1987, 7).

The cost of the CHAMPUS Program has expanded dramatically over the years as exemplified by the growth from 710 million dollars in 1980 to more than $2.3 billion dollars in 1987 (CBO 1988, 1). Military treatment facilities have reduced the availability of care to many nonactive beneficiaries which has also attributed to the rising costs of CHAMPUS.

In 1983, Congress directed that DOD establish a mechanism for CHAMPUS payment of inpatient care that was similar to the Medicare Prospective Payment System. CHAMPUS reimbursement had previously been based on billed charges. The Congressional action was in response to escalating costs of CHAMPUS hospital expenses which were rising fifty percent faster than hospital costs in general. It was also thought that the CHAMPUS program was the victim of cost shifting created when other third party payors implemented cost controls (Federal Register 1987, 32993).

Implementation of the CHAMPUS DRG-based payment system was effective 1 October 1987. Data was gathered from the implementation of the Medicare system as well as from a CHAMPUS DRG program tested in South Carolina. The overall goals of the CHAMPUS DRG-based payment system are threefold. First, hospitals are to be assured fair payment for services provided while secondly, the beneficiaries and the government have reduced cost sharing requirements. Lastly, quality of care monitoring will be enhanced in conjunction with the established Peer Review Organizations under Medicare (Federal Register 1987, 32993).

Statutory authority which allows CHAMPUS to reimburse institutions based on diagnosis-related groups (DRG) is found in the Department of Defense Authorization Act, 1984, amended Title 10 Section 1079 (j)(2)(A). This states that the same reimbursement rules under title XVIII of the Social Security Act apply to CHAMPUS. In addition, the Consolidated Omnibus Budget Reconciliation Act of 1986, amended by P.L. 99-514, Section 1895(b)(6) states that all providers participating in Medicare must also participate in CHAMPUS for inpatient hospital services for admissions occurring on or after 1 January 1987 (Policy Manual 1988, Chapter 3, Section 6, 6.1.1).

Currently, the CHAMPUS DRG-based payments are applicable to inpatient hospital care. Payment is based on a discharge categorized using the DRG system which has a prospectively determined rate. Allowances are made for indirect medical education costs as well as for capital costs, direct medical education costs, and outlier cases. Hospitals are at risk for the difference between the prospective payment rate and the actual costs incurred, no matter if the cost is above or below the predetermined rate (Policy Manual 1988, Chapter 3, Sec 6 6.1.1-6.1.2). The CHAMPUS DRG-based system is applicable in the fifty states, the District of Columbia, and Puerto Rico. Presently, two states, Maryland and New Jersey, are exempted as they are deemed to have acceptable cost control payment systems in place.

Characteristics of the CHAMPUS DRG-Based Payment System

Procedural similarities exist between the Medicare Prospective Payment System (PPS) and the CHAMPUS DRG-based payment systems. However, differences exist in some types of procedures, payment amounts, and actual weights. This is primarily a reflection of the beneficiary population as the Medicare population majority is over age 65, while the CHAMPUS beneficiary population is much younger and healthier. Because of the younger age, obstetrical and pediatric services are high volume CHAMPUS services (Policy Manual 1988, Chapter 3, Sec 6, 6.1.2).

The 472 Medicare PPS FY87 DRGs are also used by the CHAMPUS DRG-based payment system. The DRGs contain 473 groupings, but DRG 438 is no longer considered valid, thus leaving 472 DRGs. Grouping is done using the HCFA "Grouper" program for FY87 and the Medicare Code Editor, or a similar program is used for classification of hospital discharges into a specific DRG. Classification is determined by the patient's age, sex, principal diagnosis (which is defined as the diagnosis found to be responsible for the hospital admission) secondary diagnoses, procedures performed, and status upon discharge. Only one DRG is assigned based on the principal diagnosis, no matter the service rendered or conditions treated. (Exceptions can occur under DRG 468, Unrelated Operating Room Procedure). The CHAMPUS Fiscal Intermediary assigns the DRG based on the information submitted by the hospital (Policy Manual 1988, Chapter 3, Sec 6, 6.1.2-6.1.3).

Inpatient costs that are covered by the CHAMPUS DRG-based payment include routine services such as room, board, therapy, nursing care, and supplies appropriate to the patient's treatment. Ancillary services such as laboratory and radiology are paid according to the technical aspect of the test and does not include the professional component. Costs for special care units are covered as are the cost of take home medication if less than forty dollars. Malpractice insurance costs that are inherent in the provision of inpatient services are also covered (Policy Manual 1988, Chapter 3, Sec 6, 6.1.7-6.1.8).

Currently, all services covered under the psychiatric DRGs (424-432) and the substance abuse DRGs (433-438) are exempt from the CHAMPUS DRG-based payment system. Kidney acquisition, heart transplantation, and liver transplantation are also exempt. The services of hospital-based professionals are not included in the DRG payment and payment is determined by the allowable charge methodology (Policy Manual 1988, Chapter 3, Sec 6, 6.1.10-6.1.12).

Some pediatric diagnoses related to bone marrow transplants, HIV seropositive patients, and discharges with the diagnosis of cystic fibrosis are exempt from the DRG-based payment. Also, all discharges that involve newborns and infants less than twenty-nine days old at admission, except those classified in DRG 391 (Normal Newborn) are exempted. These exemptions fall under P.L. 100-202 of the 1988 Department of Defense Appropriations Act which is valid for FY88 only (Policy Manual 1988, Chapter 3, Sec 6, 6.1.12-6.1.13).

The determination of the DRG weights for use in the CHAMPUS system utilized charge data collected for all hospital claims processed by CHAMPUS from 1 July 1986 through 30 June 1987. This data was modified to exclude exempt hospitals, interim bills, and charges not allowed under the hospital DRG payment. Exempt services for psychiatric and substance abuse were also removed. Also, any combined mother and newborn bills were excluded as the DRG payment would be based on separate DRGs. (Policy Manual 1988, Chapter 3, Section 6, 6.1.30-6.1.31.). The records reviewed during this time period reflected the allowable charges paid by CHAMPUS. These charges could have been affected by cost shifting mechanisms within various hospitals which would adjust the weights higher than if the hospitals were under a cost control program.

Charges and adjusted charges for teaching hospitals (based on an indirect medical education factor) are summed for each DRG category and divided by the total cases in each DRG. Then, a total of all charges is divided by the total records of all DRGs to derive a national average. Each separate DRG average charge is then divided by the national average which results in the relative weight for the DRG category. Medicare weights are used if there are less than 10 records in a single DRG. Updates are required yearly to reflect changes in hospital resource use such as new technology. Percentage changes can be made based on Medicare adjustments; while on the minimum of every three years, all CHAMPUS weights will need to be recalculated (Policy Manual 1988, Chapter 3, Sec 6, 6.1.31-6.1.33).

Calculation of CHAMPUS DRG Payments

Calculation of the actual DRG payment to be made for an individual claim is calculated in the following manner (Policy Manual 1988, Chapter 3, Sec 6, 6.1.29-6.1.31):

1. Determine the DRG.

2. Determine the status of the hospital, urban or rural according to Table 3 of the CHAMPUS Policy Manual Vol II Chapter 3, Addendum I, dated 8 October 1987. Fayetteville, North Carolina and Cumberland County, North Carolina are classified as urban areas with the wage index of .7983. The nonurban area wage index for North Carolina is .7650. Calculation of study DRG payments would be based on the urban wage index for Fayetteville and Cumberland County, North Carolina.

3. Next, multiply the adjusted standardized amount (ASA), labor portion which is $2,066.24 for urban hospitals and $1,969.83 for rural hospitals by the wage index of the servicing hospital.

Example: $2066.24 x .7983 = $1649.48.

The ASA is the adjusted average operating cost for all CHAMPUS beneficiaries in all DRG categories during the period of time. First, the Medicare cost to charge ratio of .66 is used to reduce charges to cost. Then, bad debt expenses that can be attributed to CHAMPUS are applied to the base standardized amount. (This is an increase of .01.) An inflation factor which is determined by the hospital market basket index used by HCFA is added to arrive at the total cost. The total costs can now be divided by the total number of discharges to give a standard non-teaching amount. Further mathematical standardization is also done.

4. Add the non labor portion of the ASA $776.69 for urban and $584.08 for rural hospitals to answer above.

Example: $1649.48 + $776.69 = $2426.17

5. This amount is multiplied by the weight of the specific DRG

2426.17 x .4649 = $1127.97

(DRG 373 - Vaginal Delivery w/o complicating diagnosis)

6. Outlier amounts are determined and added to the above.

7. If appropriate, this amount is multiplied by one plus the indirect medical education adjustment factor which is calculated for each teaching hospital.

8. In addition, adjustments can be made to the figure represented by the DRG weight multiplied by the ASA. CHAMPUS will pay annually for capital costs. This payment is based on a

ratio of CHAMPUS inpatient days that is applied against the hospital's total allowable capital costs. Direct medical education costs which are reported annually to the CHAMPUS fiscal intermediary are based on the ratio of CHAMPUS inpatient days to total hospital inpatient days. This is then applied against the total allowable direct medical education costs. (Policy Manual 1988, Chapter 3, Sec 6, 6.1.34-6.1.37).

The Office of CHAMPUS (OCHAMPUS) provides a quarterly CHAMPUS Cost and Workload Report for each facility to show utilization and health care expenditures. Data is collected over a 15-month period for a designated twelve month period. Beneficiaries have up to two years from the date of the service to place a claim. Data for Hospital Services for FY85, 86, and 87 are listed as 90% complete (User Guide 1988, 1-3).

The inpatient specialty designations are extracted from the ICD-9-CM codes submitted on the hospital payment records and converted to the ICDA-8 values. Specific assignments to specialty areas require some clarification. For example, pediatric care is not a separate category. Pediatric medical diseases or surgery episodes are included in that particular medical or surgical category. Special pediatrics included neonatology and congenital anomalies. Psychiatry Group I covers mental disorders, while Psychiatry Group II contains alcoholism, substance dependence, and behavioral disorders. The remaining specialty designations are grouped into categories under Internal Medicine, Surgery, O'stetrics, and Gynecology (Users Guide 1988, 2-1 - 2-2).

The DRG categories are reported to OCHAMPUS but are currently not available for dissemination into the MTFs in the CHAMPUS Cost and Workload Report. The inpatient category listings provide an outline of high volume and high cost areas that can be used by the local MTF in overall planning. See Table B.

MEPRS

The Medical Expense and Performance Reporting System (MEPRS) is a Department of Defense System to ensure that the procedures for reporting performance, expense, and manpower data for fixed medical and dental treatment facilities are uniform across the services. Integral to this system is the Uniform Chart of Accounts Personnel Utilization System (UCAPERS) which compiles personnel utilization data for actual time worked in a specific area. UCAPERS is combined with an expense assignment system which allocates expenses based on workload. This data may be used for: allocation of resources; management studies and reports; measurement of performance for internal and civilian sector comparison; and measurement of costs and efficiency (MEPRS 1986, 1).

As cost information from the MEPRS system was used to determine Womack's average cost per DRG, a brief description of the system is in order. First, all hospital work centers are identified by an alpha code which has three components. The first space is the Functional Code which indicates inpatient or outpatient services. The second space letter determines the major clinical service which is called the Summary Code. The third space indicates the Subaccount Code which is the subspecialty of the major clinical specialty. An example is the code AAA which is inpatient internal medicine; while ABK is inpatient urology, a part of the Surgical Service (MEPRS 1986).

The most important aspect of the MEPRS system is that all aspects of care and services rendered are charged against an account which, through a step-down process, culminates in assignment against a final operating expense account. This is the mechanism by which operating expenses such as maintenance and personnel costs are charged to the final operating expense accounts. Jointly operated areas such as the general medicine nursing units would have nonpersonnel expenses prorated based on types of workload; while personnel expenses are assigned according to percentage of time worked (MEPRS 1986, 2A-17).

To further illustrate the capturing and assignment of costs to a final operating expense account, several examples are presented. First, each work center has a performance factor that is a measurement of workload. Under the ancillary services functional account of surgical services, each work center of anesthesiology, surgical suite, and recovery room has a performance factor of minutes of service. The cost for these minutes of service are assigned to a final operating expense account such as General Surgery, Oral Surgery, Urology, and Gynecology. In this manner, all aspects of patient care services rendered can be documented and assigned to a final operating expense account (MEPRS 1986, 2D-5, 2D-19). A similar procedure occurs with Support Services such as the expensing of depreciation, administration, plant management, utilities, and property maintenance (MEPRS 1986, 2E-3-4).

The review of the MEPRS system highlighted the significance of accurate data. The cost output is dependent on the data that enters the system, particularly true in the allocation of manpower data. Physicians work in both the inpatient and outpatient settings. Inaccurate accounting of hours can easily overestimate one account while underestimating another. The same holds true for accurate accounting for services such as laboratory, radiology, and nuclear medicine.

Mehra (1986, 234) noted that a hospital's ability to monitor costs was directly related to its ability to accurately gather and analyze data. He noted that there is disagreement among hospitals concerning money-making versus money-losing DRGs. Teaching hospitals, in particular, feel that all DRGs are necessary for teaching. The overall strategic direction should be geared to cost effectiveness wherein management should look at and review the entire operation over a period of time. This would allow identification of areas in which costs may be reduced rather than focusing on only money-losing areas.

Another significant observation of the MEPRS system is that it captures the fixed costs of the facility which are proportionately assigned to the final operating expense accounts. The fixed costs can be considered high because of salaries and equipment costs. The cost performance factor, such as occupied bed days, can be decreased by increasing volume. Using obstetrics as an example, a low volume will increase the occupied bed day costs; while an increase in volume will decrease the occupied bed day costs. Employees whose salaries are a fixed cost are still paid when patient volume is low. Management's challenge is to utilize personnel in the most efficient manner and correctly document the manpower data.

Quantitative Approach to Decision Making

Management is the planning, organizing, and control of operations. Methods used to enhance this process can be quantitative as well as qualitative. Scientific methodology has been applied to management problems in the form of industrial engineering in determining productivity and work scheduling.

Frederick W. Taylor and Henry L. Gantt focused on the individual phases or steps of an operation (Levin, Rubin, and Stinson 1986, 10).

During the early sixties, emphasis began to be placed on the broader aspects of management which was the beginning of management science/operations research (MS/OR). Management science can be described as a multidisciplinary approach to complex problems. This is further defined as "the systematic study of a problem involving gathering data, building a mathematical model, experimenting with the model, predicting future operations, and getting the support of management for the use of the model" (Levin, Rubin, and Stinson 1986, 35).

Levin, Rubin, and Stinson (1986, 5-8) describe the MS/OR process as a six step procedure. First, the problem environment must be assessed by means of data collection through listening and observations to discern the problem. The second step is to develop the research objectives by defining the type of problem and then determining those aspects of the problem which are within management's control. The third step is to develop a model that will mathematically represent the problem to include the stated environmental constraints. Appropriate data for inclusion in the model is the next step. This is followed by the solving of the model under the assumptions that have already been determined. The results are solutions that can easily support organizational objectives. However, adjusting the inputs to determine the effect on outputs can be done through sensitivity analysis. The sensitivity analysis allows experimentation without making operational errors with implementation being the final step. With the use of any model, the limitations of that model must be understood, such as the conditions under which the model will and will not work. (Levin, Rubin, and Stinson 1980, 7-8).

Linear programming originated around 1760 with Francois Tuesnay's attempt to describe the economic relationship of the roles of the landlord, peasant, and artisan. This began with the idea of how to distribute scarce resources among competing activities in order to reach an acceptable output. Wassily Leontieff developed a linear programming model during the depression of the 1930s which detailed the entire United States economy. Further developments in linear programming were geared to military as well as industrial uses (Levin, Rubin, and Stinson 1986, 12-13).

Linear programming is a technique based on mathematics to determine the best means of utilizing the resources of an organization. Linear depicts a relationship between two or more variables which is directly proportional, while programming is the use of mathematical techniques to determine an optimal solution in the face of scarce resources. A linear programming problem must have four basic elements. The first is the presence of an achievable objective; and the second is having alternative courses of action available to achieve the stated objective. The third element is the limitation of resources and fourth, both the objective and limitations of the problem must be convertible to mathematical equations or inequalities. Equality equations are very specific and limit the alternatives, whereas an inequality specifies only minimum or maximum limits which in turn offer more potential courses of action (Levin, Rubin, and Stinson 1986, 328-329). Warner, Holloway, & Grazier (1984, 23) further define the objective function as a means of relating the objective to be achieved with the available alternatives.

Linear programming problems may be solved graphically if there are no greater than three variables used. However, the use of three or less variables is limiting. The development of the simplex method by George Dantzig allows the use of many variables and uses a systematic, patterned approach to finding an optimum solution. This can be done mathematically by hand using the simplex tableau. This is an iterative process which begins with an initial solution which will progress to the optimal solution. Artificial variables may be added to the minimization objective as computational devices to permit calculations of equality and greater than or equal to constraints. These artificial variables should not be present in the final solution so they are assigned a high numerical value. Slack variables are added to the less than or equal constraints; while surplus variables are added to greater than or equal to constraints. These slack variables have a zero cost factor. A series of computations occur to obtain the final solution (Levin, Rubin, and Stinson 1986, 364-387).

A study of MS/OR activities done in 1983 showed that linear programming was fourth in overall usage of quantitative techniques. Formulation of the problem is the more difficult aspect of using linear programming as computer packages are available to quickly produce solutions. Calculations by hand with the simplex tableaus for problems with many variables would be very difficult. Examples of industrial use include: matching production with seasonal demand; maximization of the return on portfolio investments; ingredient mix for food production; and textile production with an emphasis on profit as well as coping with a recession. (Levin, Rubin, and Stinson 1986, 420-421).

Linear programming has been utilized in the hospital environment in determining patient mix. Baligh and Laughhunn (1969, 293) developed a linear programming model for planning admissions based on the value of the patient to the hospital and the patient's requirements for hospital resources. Brandeau and Hopkins (1984, 32) later developed a hospital financial model that determined the effect on the hospital's income, expenses, and resource use by changing the mix of patient by payer class and intensity level. The model was used as a strategic planning tool in optimization analyses as well as in analysis of marginal effects of changes in case mix. Emphasis was placed on the model being utilized on a strategic planning level rather than used for making detailed operational decisions.

Broyles and Rosko (1986, 67-68) further emphasize the use of linear programming in adjusting inpatient mix to maximize income or to minimize net losses. They recognize that hospital administrators can also evaluate shadow prices to determine the incremental changes that occur as resources are used in reaching the optimal solution. They further note that use of computer models enhance the ability to perform sensitivity analyses. As the problem data change, how does it effect the optimal solution? Understanding these sensitivities, management can adjust cost components, change capacity, or make changes in institutional policies.

Research Methodology

The research methodology began with an extensive review of the available literature on the history of Diagnosis Related Groups System and Case Mix management. Because of the large volume of material available, the focus was placed on management's role in the DRG system.

Next, the CHAMPUS program was reviewed in depth from its inception through the spiraling costs to its current DRG based payment system. This established the basis for the calculation of the CHAMPUS DRG payments.

The MEPRS accounting system was described in detail. This discussion established the basis for the calculations of Womack costs per DRG.

The final element of the literature review examined linear programming as a quantitative technique used in Management Science. This was explored from its early history to present day use. (Specific requirements for formulation of the objective function and constraints were examined in detail.)

A description of the study environment follows. The hospital mission and workload were analyzed to determine high volume and high cost DRGs over the periods of FY 85, 86, and 87. A similar procedure was performed for the CHAMPUS workload. From this analysis, the DRG categories were chosen for the study. A description of the mechanism to determine Womack's average cost per selected DRG was presented here.

The average cost was determined from FY 87 MEPRS data. This reported the average cost per occupied bed day per work center. The work center is also known as the clinical service. On admission to the hospital, each patient is assigned to a clinical service. This clinical service code is the charged unit for all services that the patient receives while hospitalized. For example, a patient on the Obstetrical service has an average cost per occupied bed day of $297.68 and an average length of stay of 2.6 days for a total average cost of $773.96 per Obstetric admission.

The DRG cost was determined by the clinical service and the average length of stay for that particular DRG at Womack. For example, DRG 373 (Vaginal Delivery Without Complicating Diagnoses) has a mean length of stay for Fort Bragg of 2.9 days. This would then give an average cost per DRG 373 of $863.27 ($297.68 x 2.9).

The average length of stay per DRG for WACH was a key factor in determining the average costs. These average costs were used as the cost coefficient in the objective function of the linear program.

The weights for each DRG used in the study were based on the FY 88 published CHAMPUS weights. The Health Care Financing Administration (HCFA) determines a constant weight for each DRG for all hospitals. This weight is reflective of the use of hospital resources for that particular DRG category. As military weights per DRG are not available, it was determined that the CHAMPUS weights were more reflective of the military population than the HCFA weights. These weights were categorized into low, medium, and high ranges of resource intensity.

Formulation of the Linear Model

The objective function of the linear model was to minimize the overall cost to the government of providing health care for selected diagnoses by using the CHAMPUS DRG rates and Womack costs. Constraints were then applied to the objective function.

The variables were defined as:

i = the DRG category (i = 1,2,..9, A...D)

j = the intensity of resource use (low, medium, and high) (j = 1,2,3)

X_{ij} = the number of CHAMPUS patients with DRG category i and intensity of resource use j.

Y_{ij} = the number of Womack patients with DRG category i and intensity of resource use j.

The objective function was defined as:

$$\text{Minimize } Z \text{ (Cost)} = \text{CHAMPUS DRG cost} \sum X_{ij} + \text{Womack Average Cost} \sum Y_{ij}$$

Formulation of Constraints

The upper and lower limits for bed capacity for six clinical services (Medicine, EENT, Pediatrics, Surgery, Orthopedics, and Obstetrics) were established. The total number of beds per clinical service at Womack was multiplied by 365 days per year to obtain the available bed days per year. These bed numbers were adjusted proportionate to the study of DRGs.

Training constraint formulation was based on input from the various chiefs of the teaching programs. These were incorporated into the constraints for lower limits on bed days and specific DRGs.

Personnel constraints for physicians and nursing staff were divided by clinical specialty. The JHCMS were the basis for determining upper limits. Physician upper limits were based on the number of recommended inpatient days per physician multiplied by the average assigned Womack physicians. These upper limits were proportionately adjusted to the study DRGs.

Nursing staff (professional and paraprofessional) constraints also utilized the JHCMS with nursing hours used as the unit of measurement. Nursing hours required by the study DRGs were calculated and proportionately adjusted to the Womack staff by using actual hours worked.

Lower limits were established for the CHAMPUS variables. These were based on FY87 usage and proportionately adjusted. Then, a total estimated demand for inpatient care for these DRG variables was calculated.

All X_{ij} and Y_{ij} values were greater than or equal to zero, to preclude negative numbers. This was integral to the program software.

Quality issues and points raised by the medical and nursing staffs were incorporated into the existing constraints.

Solving the Linear Model

Using all the data compiled and formulas as given, the model was solved for the optimal mix of CHAMPUS and in house care to minimize the overall costs to the government of selected DRGs.

A commercially prepared linear programming computer program was utilized. This was Computer Models for Management Science by Erikson and Hall, published by Addison-Wesley Publishing Company which was a computer program was designed for student use.

A major contingency was that the solution would have to be feasible to allow implementation. A sensitivity analysis was also performed to define areas for improvement or flexibility.

Management Strategy Development

Using the derived solution, management strategies were developed as recommendations for the optimal mix of inpatient services. This solution focused on the best distribution of workload of selected DRGs for care at Womack and through CHAMPUS.

DISCUSSION

The Study Environment

Missions

The mission of the USA MEDDAC, Fort Bragg, North Carolina:

> To provide health services to authorized personnel within the Fort Bragg Health Service Area including: Inpatient and outpatient medical care and treatment to active and retired military personnel, their family members and other personnel as authorized by the Department of the Army...conducts DA and HSC directed training course; i.e., OB/GYN Nurse Clinical Course, Patient Care Specialist (91C) Course, Family Practice Residency, Physician Assistant, Orthopedic Specialist (91H) Course, Occupational Therapist (91L) Phase II) Course, Dental Corps Residency, Anesthesiology for ANC Officers, Phase II, Pharmacy Residency, USA/Baylor University Program, OR Specialist Phase II, Physical Therapy Specialist Phase II, Medical Technology, X-Ray Specialist Phase II, and Nuclear Medicine Specialist Course... (TDA HSW2L6AA)

Of these designated teaching missions, those with the greatest complexity, use of services, and numbers of students are the OB/GYN Nurse Clinician Course, Patient Care Specialist (91C) Course, and the Family Practice Residency. The OB/GYN Nursing Course, which graduates twelve students three times per year, has as its overall goal the provision of a sound foundation in Maternal Nursing. Major Kathleen Shinners, Director of the course, noted that the students received the basic foundations in maternal nursing through the volume of "bread and butter" type obstetric population seen here at Fort Bragg. The current type and volume of patients seen is entirely adequate for meeting the course objectives.

The Patient Care Specialist (91C) Course graduates sixty students twice per year. This course requires that these practical nursing students receive a broad range of clinical nursing skills in Medicine, Surgery, Obstetrics, Emergency Care, and Ambulatory Care areas. The proponent for this course is the Academy of Health Sciences at Fort Sam Houston, Texas with nursing accreditation through the State Board of Nursing in Austin, Texas. The current mixture of patient services has proved adequate for the clinical needs of the student population (Frank 1988).

The training program with the most restrictive and comprehensive requirements and operating guidelines is the Residency Program in Family Practice. The hospital has been a site for a Family Practice Residency Program since 1974. Accreditation for the program is by the Accreditation Council for Graduate Medical Education (ACGME) with the Residency Review Committee for Family Practice making the recommendations for continued accreditation. The Residency Review Committee is composed of representatives from the American Academy of Family Physicians, the American Board of Family Practice, and the AMA Council on Medical Education. The Residency Program currently has twenty-eight students spread through three levels of training and has eight full time faculty members with seven faculty support physicians.

Specific guidelines as to the educational needs of the Family Practice residents center on the availability of clinical experiences in the areas of Family Practice, Gerontology, Human Behavior and Psychiatry, Community Medicine, Internal Medicine, Dermatology, Pediatrics, Obstetrics and Gynecology, Surgery, Emergency Medicine, Diagnostic Imaging, and Practice Management. Internal Medicine must provide structured experiences in cardiology critical care units and neurology. Surgical experiences are required in general surgery and the subspecialties of orthopedics, ophthalmology, otolaryngology, and urology. (These subspecialty experiences are concentrated in outpatient experience.) Length of time of the educational level and availability of the services are the criteria for each type of experience along with a general outline of type of clinical experiences to be completed. Facility requirements include a minimum of 135 occupied beds per day while inpatients must be available in sufficient numbers to provide a broad spectrum of problems that are commonly seen in the general community. (ACGME 1987, 8-11). The Director of the Family Practice Residency Program stated that the current assigned mix of specialty physicians is adequate; although the lack of a cardiologist has required the use of the Veteran's Administration Hospital for experiences in cardiology (Powers 1988).

Analysis of Workload

The catchment area population served by WACH for FY87 was estimated at 132,036. (See Table A for a breakdown by beneficiary title). A review of both the CHAMPUS and WACH workload during FY87 was completed. CHAMPUS workload was addressed first.

During FY87, 4,159 hospital admissions for 31,680 hospital days were reported by CHAMPUS. This further averaged out to a daily patient load of 86.79 and overall government cost of $15,625,285 (HR 085-007-1-11-88). These figures were obtained from a quarterly CHAMPUS Cost and Workload Report that is prepared for each facility showing utilization and health care expenditures. Data is collected over a fifteen-month period for a designated twelve-month period. As beneficiaries have up to two years from the date of the service to place a claim, data compiled for the hospital services section is listed as ninety percent complete (User Guide 1988, 1-3).

An analysis of the hospital services by specialty category was done. Table B indicates those specialties which are: (1) High volume by admission; (2) High total Govt cost; (3) High Govt cost per admission; and (4) High Govt cost per day. The components of each group remained consistent over the past three years with some fluctuations within the group. This can be attributed to the availability of specialties and the issuance of certificates of nonavailability from Womack.

In order for WACH to fully utilize the data supplied by the Quarterly CHAMPUS Cost and Workload Report, two major points must be known. First, even though hospitals submit ICD-9-CM codes on payment records, Office of CHAMPUS (OCHAMPUS) cannot currently report usage by DRG. Therefore, Womack specific CHAMPUS data is based on broad inpatient specialty care areas. The second point is that the categorizations do not include General Pediatrics. Pediatric medical diseases or surgery episodes are included in that particular medical or surgical category. The category of Special Pediatrics covers neonatology and congenital anomalies (Users Guide 1988, 2-1 - 2-2). These factors were taken into consideration when developing the DRGs to be used in this study. The largest provider of CHAMPUS care in the area is Cape Fear Valley Regional Medical Center. Ten percent of their payer mix is CHAMPUS and much of this is because of the high volume of obstetrical care provided at this facility. The other two hospitals in the area average less than two percent of their payer mix as CHAMPUS.

For FY87, Womack Army Community Hospital had 17,637 dispositions and 70,763 bed days. The cost for the provision of these inpatient services according to the MEPRS data was $20,445,212, excluding clinician salaries.

Workload data by DRG was available for WACH for FY85, 86, and 87. The FY85 and 86 data was compiled by the Tri-Service

Performance Measurement Working Group using the IPDS (Inpatient Data System) which were converted to the ICD-9-CM (International Classification of Diseases, Ninth Revision with Clinical Modification) 1979. The Health Systems International Grouper Program was then used to assign DRG values. The FY87 data was compiled by the US Army Patient Administration Systems and Biostatistics Activity (PASBA) using the current methodology. Three years of data were reviewed to look at the consistency of the high volume DRGs. Then, the average length of stay for FY87 was used as it was most representative of the recent trend in care at WACH.

Thirty-eight DRGs were identified as high volume at Womack which were defined as an average of greater than one hundred admissions per year over the three fiscal years surveyed. During FY87, these DRGs accounted for 55 percent of the total Womack admissions (9720 of 17,637) and 43.24 percent of the total occupied bed days (30,601 out of 70,763 occupied bed days).

The case mix for WACH based on a Standardized Relative Case Mix Index for Health Services Command (HSC) in FY85 was 0.9332. By comparison, the actual Womack case mix based on HCFA weights would be 0.6798. This lower number reflects the younger patient population and military unique admissions required for many soldiers. The FY86 Womack case mix was 0.6681 while the HSC

Relative Case Mix Index for WACH was not calculated. (Tri-Service Performance Measurement Working Group 1987, 1.) The FY87 Case Mix Index being compiled by PASBA is not yet available.

Formulating the Linear Model

The application of a linear programming model for the determination of the optimal mix of inpatient service at WACH met the aforementioned criteria for a linear programming model. The overall objective was to minimize the governmental cost of providing care to eligible beneficiaries in the Fort Bragg catchment area. Alternative courses of action were available by determining the ratio and types of diagnoses to be treated at the MTF and those to be treated at civilian facilities through the CHAMPUS DRG-based system. *Limitation of resources* determining in-hospital usage at WACH were available beds and personnel staffing. Another limitation on resources related to the mission of the military hospital and its various teaching programs. Each has specific requirements and experiences that must be met in order to maintain readiness and accreditation.

Development of the Objective Function

The purpose of the objective function was to minimize the overall government costs of selected DRGs using CHAMPUS DRG costs and Womack costs. The selection of the DRGs to be used was based on the High Volume, High Cost categories of CHAMPUS (see Table B) and Womack's high volume, high cost DRGs. CHAMPUS groups that will be excluded are the Psychiatric, Substance Abuse, and Special Pediatrics Diagnoses. Psychiatric diagnoses are currently excluded from the DRG-based payment system while the Special Pediatrics fall under the exclusion from DRG-based payment under P.L. 100-202, the 1988 DOD Appropriations Act. The CHAMPUS categories chosen for use in the study were: Obstetrics, Gynecology, Cardiology, Orthopedics, Neurology, Gastroenterology, Urology, and ENT. As the specific DRGs within these CHAMPUS categories are not available, the study DRGs were based on a combination of both volume and cost per admission of the CHAMPUS Clinical Service categories in combination with high volume and high cost Womack DRGs. See Table C for a summary of the study DRGs.

Calculations of Cost Coefficients.

The variables were defined by DRG category and weight. X variables refer to CHAMPUS, while Y variables refer to Womack. Of the X_{ij} and Y_{ij} variables, the i corresponded to the DRG category which ranged from one through nine and A through D. The j corresponded to the weight or intensity of resource use. CHAMPUS weight are used rather than HCFA weights as these were developed with CHAMPUS population data. DRG weights are not yet available for DRGs within the Department of Defense. Weights were divided into the categories of low ($j \leq .5000$), medium ($.5000 \leq j \leq .7000$), and high ($j \geq .7000$). The weights ranged from a low of .3202 to a high of 1.6771. See Table D for the Variable Identifier Table.

The calculation for the CHAMPUS DRG cost is computed from the DRG descriptions and weights found in the CHAMPUS Policy Manual, Volume II, Chapter 3, Addendum 1, Table 4, dated 8 March 1988. Table 5 of the same reference was used for the national urban adjusted standardized amount. For the purpose of these calculations, outliers will not be used. Also, the indirect medical education standardization factor will not be used as none of the hospitals in this area are classified as teaching hospitals. The annual payment for capital costs based on the ratio of CHAMPUS inpatient days to the total patient inpatient days is recognized, but excluded for this study. Addition of these costs will only serve to increase CHAMPUS payments.

An example for the calculation of the CHAMPUS DRG payment using DRG 29, Traumatic Stupor and Coma < 1 Hr, Age 18-69 w/o C.C. follows.

1. $2066.24 (Labor ASA - Urban) x .7983 (wage index) = $1649.48

2. $1649.48 + $776.69 (nonlabor ASA - urban) = $2426.17

3. $2426.17 x .7013 (DRG Weight of #29) = $1701.47

Table E lists the CHAMPUS Reimbursement for selected DRGs effective for discharges occurring after 1 March 1988.

The calculation of the Womack costs per DRG is based on the FY87 MEPRS Inpatient Care Final Operating Expense Accounts.

These were compiled without clinician salaries to better approximate the CHAMPUS DRG-based payment system. See Table F. The cost per occupied bed day of the appropriate clinical service was multiplied by the length of stay to determine the selected DRG rate. See Table G.

The completed objective function would minimize the overall government cost of selected DRGs through treatment at Womack and payment via the CHAMPUS DRG-based system.

$$\text{Min } Z = \sum C\, X_{ij} + \sum C\, Y_{ij}$$

or MIN Z =

1701	X13+	1687	X22+	1112	X31+	1202	X41+	1459	X42
+1545	X52+	1957	X53+	794	X61+	1326	X62+	1154	X71
+1605	X72+	1795	X73+	1815	X83+	1396	X92+	1026	XA1
+1664	XA2+	2376	XA3+	904	XB1+	1627	XB2+	2254	XB3
+ 998	XC1+	1296	XC2+	828	XD1+	4069	XD3+	700	YB13
+ 869	Y22+	875	Y31+	933	Y41+	1071	Y42+	1428	Y52
+1763	Y53+	642	Y61+	1158	Y62+	805	Y71+	792	Y72
+1599	Y73+	1428	Y83+	1092	Y92+	950	YA1+	1283	YA2
+2708	YA3+	655	YB1+	834	YB2+	1280	YB3+	807	YC1
+1092	YC2+	420	YD1+	3014	YD3				

See Appendix D for the complete computer model for constraints, results, and sensitivity analysis.

<u>Formulation of the Constraints.</u>

The formulation of the constraints began with the limitations of the WACH facility bed capacity. The bed capacity for each clinical service represented was determined for one year. The clinical services identified were Medicine, EENT, Pediatrics, General Surgery, Orthopedics, and Obstetrics. The lower limits for each service were established as ten percent lower than the base year of FY87. The upper limits were established as ten percent above the base year of FY87 workload. See Appendix A for these calculations.

The bed capacity constraint is a summation of the variables times the average length of stay for each. This total must be less than the upper limit and greater than the lower limit. Lower limits were established to ensure occupancy and variety of patients to meet training requirements.

Medicine Upper Limit Bed Capacity

2.5 Y13 + 3.4 Y52 + 4.2 Y53 + 2.8 Y62 + 5.1 Y83 + 3.9 YC2 + 1.5 YD1 $\leq$ 6024 (NOTE: This constraint was calculated but not added to the program as it was redundant with the Medicine Physician Constraints)

EENT Upper Limit Bed Capacity

2.5 Y22 + 3 Y31 $\leq$ 1470.95 (NOTE: This constraint was calculated but not added to the program as it was redundant with the EENT Physician Constraint.)

<u>Constraint 1.</u> Pediatrics Upper Limit Bed Capacity

2.3 Y31 + 2.7 Y41 + 3.1 Y42+ 2.4 Y61 + 2.9 YC1 $\leq$ 1883.4

Surgery Upper Limit Bed Capacity

5.2 Y62 + 3.2 Y92 + 2 YA1 + 2.7 YA2 + 5.7 YA3 + 10 YD3 $\leq$ 5577

(NOTE: This constraint was calculated but not added to the program as it was redundant with the Surgeon Constraint.)

Constraint 2. Orthopedics Upper Limit Bed Capacity

$3.2\ Y71 + 3.2\ Y72 + 6.3\ Y73 \leq 9285.6$

Constraint 3. Obstetrics Upper Limit Bed Capacity

$2.9\ YB1 + 2.8\ YB2 + 4.6\ YB3 \leq 9125$

Constraint 22. Medicine Lower Limit Bed Capacity

$2.5\ Y13 + 3.4\ Y52 + 4.2\ Y53 + 2.8\ Y62 + 5.1\ Y83 + 3.9\ YC2 +$
$1.5\ YD1 \geq 2080.5$

Constraint 23. EENT Lower Limit Bed Capacity

$2.5\ Y22 + 3\ Y31 \geq 521.95$

Constraint 24. Pediatrics Lower Limit Bed Capacity

$2.3\ Y31 + 2.7\ Y41 + 3.1\ Y42 + 2.4\ Y61 + 2.9\ YC1 \geq 1007.4$

Constraint 25. Surgery Lower Limit Bed Capacity

$5.2\ Y62 + 3.2\ Y92 + 2\ YA1 + 2.7\ YA2 + 5.7\ YA3 + 10\ YD3 \geq 1124$

Constraint 26. Orthopedic Lower Limit Bed Capacity

$3.2\ Y71 + 3.2\ Y72 + 4.7\ Y73 \geq 5781.6$

Constraint 27. Obstetric Lower Limit Bed Capacity

$2.9\ YB1 + 2.8\ YB2 + 4.6\ YB3 \geq 7725.6$

Personnel Constraints

The next set of constraints dealt with personnel staffing, both physician and nursing personnel. The standards utilized in this study were the draft version of the Department of Defense Joint Health Care Manpower Standards (JHCMS) published by the Office of the Secretary of Defense (Health Affairs) (January

1988). These standards are undergoing evaluation for final approval. However, they offered the most complete currently available mechanism to quantify the requirements for a hospital facility. The purpose of the standard is to ensure a uniform mechanism of determining medical staffing requirements for DOD medical treatment facilities.

In developing the physician constraints, several sources were evaluated. First, the results of the Graduate Medical Education National Advisory Committee (GMENAC) were reviewed. Data for this was compiled in the late 1970s from the U.S. Census Data on Population Projections, the American Medical Association, and the American Osteopathic Association listings of physician specialties. This data was combined with epidemiological data concerning incidence and prevalence of disease, standards of patient care, and physician productivity guidelines to project 1990s physician requirements by specialties. In addition, a Delphi panel of experts were used to further refine the data. However, the productivity guidelines counted inpatient care by number of visits rather than by number of bed days (1980, 10-12). Because of the additional data necessary to collect to transform inpatient visits to bed days, and the unique nature of military hospitals, it was decided not to use the GMENAC standards.

The JHCMS used were a draft that was pending further analysis by DOD prior to implementation. Problems identified with the standards by the Office of the Assistant Secretary of the Army (Manpower and Reserve Affairs) focused on the Army wartime medical readiness and the training and utilization of health care personnel that are unique to the Army. Much of the JHCMS data was based on Air Force hospitals which tend to be smaller with a different occupational injury rate among airmen than active duty soldiers. Thus, administrative support and residency program requirements were felt to have been underestimated (Army Review of JHCMS 1987, 77-80). However, each of the physician specialty standards were reviewed by the Army consultant in that specialty field and they provide the most current military health care personnel data available for physicians as well as nursing staff. The physician constraints for WACH were based on the average assigned strength rather than on requirements or authorizations in order to present a more accurate picture of the current situation.

For the Medicine Service, Internal Medicine and Family Practice parameters were used. Family Practice residents were counted as .40 while Family Practice staff were counted as .25. The calculation of the upper limit of bed days by available physician staff for the variables being evaluated was proportionate to the medicine bed days being evaluated to the total bed days for all the Medicine Service. See Appendix B for calculations.

Constraint 4.

$2.5\ Y13 + 3.4\ Y52 + 4.2\ Y53 + 2.8\ Y62 + 3.9\ YC2 + 1.5\ YD1 \leq 3293$

For the EENT service, Ophthalmology and Otolaryngology standards were used in the same manner. The upper limit of bed days to be provided by these physicians is proportionate to the EENT bed days being evaluated to the total EENT bed days for FY87. See Appendix B.

Constraint 5.

$2.5\ Y22 + 3\ Y31 \leq 792$

The Pediatric physician constraints utilized the Pediatric standards. As the standards did not address the Nursery, two physicians were pulled out of the calculation for that, while another civilian was used for full-time outpatient care. The upper limit of bed days for the pediatricians was proportionate to the number of Pediatrics bed days being evaluated to the total Pediatric bed days for FY87. See Appendix B.

Constraint 6.

$2.3\ Y31 + 2.7\ Y41 + 3.1\ Y42 + 2.4\ Y61 + 2.9\ YC1 \leq 2541$

The Surgical physician constraints included the specialties of General Surgery, Urology, and Gynecology. Family Practice residents were also considered for a combined total of three. Gynecologists were limited to one because of the heavy obstetric load. The upper limit of bed days for the surgical staff was proportionate to the number of surgical beds evaluated to the total surgical bed days for FY87. See Appendix B.

Constraint 7.

$5.2\ Y62 + 3.2\ Y92 + 2\ YA1 + 2.7\ YA2 + 5.7\ YA3 + 10\ YD3 \leq 3448$

The Orthopedic Surgeon constraints utilized the orthopedic standards. This was one instance where the number of physicians assigned was greater than the requirements or authorizations. The upper limit of bed days for the orthopedic surgeons was proportionate to the number of orthopedic bed days evaluated to the total orthopedic bed days for FY87. See Appendix B.

Constraint 8.

$3.2\ Y71 + 3.2\ Y72 + 6.3\ Y73 \leq 6510$

The Obstetric constraints began with the JHCMS, which listed births per month rather than bed days as the standard. Also, Family Practice residents and staff are very busy on this service. The average births per month for FY87 172.5. This was multiplied by an average length of stay to obtain the optimum bed days for the physician. Again, the upper limit of bed days for the Obstetric Service was proportionate to the number obstetric bed days evaluated to the total bed days for FY 87. See Appendix B.

Constraint 9

$2.9\ YB1 + 2.8\ YB2 + 4.6\ YB3 \leq 7985$

Nursing Constraints

The formulation of the inpatient Nursing Constraints were based on the JHCMS (6300 Inpatient Nursing). This utilized an acuity-based classification methodology that quantified the nursing man hours required to deliver direct nursing care. The Workload Management System for Nursing (WMSN) was the classification methodology. It has six categories of care which range from Category I, being the least acute, to Category VI, being the most acute. As the category level or acuity of the patient rises, more nursing man hours are required.

Each numerical acuity category of I through VI has an assigned workload factor. To determine the nursing manhours required, multiply the workload factor by the average monthly number of bed days for patients in that acuity category. This calculation determines the staffing requirements for that particular nursing unit.

For this study, the resource intensity category j or low, medium, and high, were matched to the patient acuity categories of I, II, and III respectively. Thus, the acuity category for each variable was determined by the j value of 1, 2, or 3. The appropriate workload factor was then multiplied by the average length of stay to determine the nursing manhours required by that variable during the hospital stay. These nursing manhours were the coefficients of the variables for the nursing constraints. The earned nursing man hours for each service constraint were determined by the nursing man hours per variable multiplied by the number of dispositions. These results were added for each service to determine the total nursing man hours required for the defined variables.

The next step looked at the number of earned nursing man hours reported for each of the services. A yearly total of earned nursing man hours as calculated by the WMSN was determined. Next, the percentage of total man hours that these variables represent was determined. Upper limits for nursing man hours were determined proportionate to the upper limits of the available bed days for that service. (The most complete nursing man hour data available was the time period of April 1986 through March 1987. The data used was part of a manpower survey report submitted to Health Services command, HSC.) See Appendix C for a complete description of calculations for each service.

Thus far, only the "ideal" number of nursing man hours as required by the WMSN has been used. It was decided to use the actual time worked as collected by MEPRS as an indication of staffing. The percentage of these actual hours worked compared to the earned hours of the WMSN was determined. This percentage was then multiplied by the upper limits of the earned man hours by the WMSN.

Constraint 10. Medicine Nursing Hours Upper Limit

$$26.425\ Y13 + 16.468\ Y52 + 44.394\ Y53 + 13.552\ Y62 + 53.906\ YB3 + 18.888\ YC2 + 2.312\ YD1 \leq 21{,}373.36$$

Constraint 11. EENT Nursing Hours Upper Limit

$$12.108\ Y22 + 4.544\ Y31 \leq 3024.95$$

Constraint 12. Pediatric Nursing Hours Upper Limit

3.475 Y31 + 4.08 Y41 + 14.722 Y42 + 3.626 Y61 + 4.382 YC1 $\leq$ 3424.77

Constraint 13. Surgical Nursing Hours Upper Limit

13.506 Y62 + 15.498 Y92 + 3.082 YA1 + 13.076 YA2 + 60.249 YA3 + 105.7 YD3 $\leq$ 34,741.45

Constraint 14. Orthopedic Nursing Upper Limits

4.931 Y71 + 15.255 Y72 + 49.528 Y73 $\leq$ 49,954.5

Constraint 15.

3.423 YB1 + 13.692 YB2 + 50.15 YB3 $\leq$ 31,071

Demand Constraints

A constraint was added to define as best as possible the demand for hospital care in the Fort Bragg area. Williams and Torrens noted that for short stay general hospitals, 1,158.2 days of care were required for every 1,000 persons (1984, 52).

The CBO study Reforming the Military Health Care System, noted that 967 days of hospital care are provided for every thousand active duty dependents. This is a higher rate than for the general population. It is attributed to a higher admission rate rather than longer length of stays (1988, 17).

Because of the need to include all the beneficiary population, it was decided to use the Williams and Torrens figure of 1,158.2 days of care per 1000 persons. This number may reflect the longer lengths of stays seen in the early 1980s, but may still give an adequate representation because of the higher admission rates.

The total demand was determined by multiplying the 1,158.2 days of care by 132.036 population factor. This total of 152,924.1 was multiplied by twenty-seven percent to represent the restricted number of diagnoses being studied. The upper limit for the demand of all the diagnoses studied was 40,888.

Constraint 50. Lower Limit for Total Demand

2.6	X13+	1.7	X22+	1.8	X31+	2.9	X41+	3.6	X42
2.4	X52+	3	X53+	2.4	X61+	2.5	X62+	2.7	X71
1.9	X72+	3.1	X73+	4.5	X83+	1.9	X92+	22.2	XA1
2.3	XA2+	4.8	XA3+	2.1	XB1+	2.8	XB2+	4.5	XB3
2.8	XC1+	3	XC2+	2	XD1+	4.7	XD3	2.5	Y13
2.5	Y22+	2.7	Y31+	2.7	Y41+	3.1	Y42	3.4	Y52
4.2	Y53+	2.4	Y61+	4	Y62+	3.2	Y71	3.2	Y72
4.7	Y73+	5.1	Y83+	3.2	Y92+	2	YA1	2.7	YA2
5.7	YA3+	2.2	YB1+	2.8	YB2+	4.7	YB3	2.9	YC1
3.9	YC2+	1.5	YD1+	10	YD3				

$\geq$ 40,888

The next set of constraints dealt with the projected demand for each service for the CHAMPUS variables. The CHAMPUS bed day lower limits were determined by using a percentage of the total number of bed days for the corresponding CHAMPUS bed days.

Constraint 16. Lower Limit Demand for CHAMPUS Medicine Bed Days

2.6 X13 + 2.4 X52 + 3 X53 + 2.5 X62 + 4.5 X83 + 3 YC2 + 2 XD1 + $\geq$ 3000

Constraint 17. Lower Limit Demand for CHAMPUS EENT Bed Days

1.7 X22 + 1.8 X31 $\geq$ 175

Constraint 18. Lower Limit Demand for CHAMPUS Pediatric Bed Days

$$1.8\ X31 + 2.9\ X41 + 3.6\ X42 + 2.4\ X61 + 2.8\ XC1 \geq 2400$$

Constraint 19. Lower Limit Demand for CHAMPUS Surgical Bed Days

$$2.5\ X62 + 1.9\ X92 + 2.2\ XA1 + 2.3\ XA2 + 4.8\ XA3 + 4.7\ XD3 \geq 1750$$

Constraint 20. Lower Limit Demand for CHAMPUS Orthopedic Bed Days

$$2.7\ X71 + 1.9\ X72 + 3.1\ X73 \geq 900$$

Constraint 21. Lower Limit Demand for CHAMPUS Obstetric Bed Days

$$2.1\ XB1 + 2.8\ XB2 + 4.5\ XB3 \geq 6000$$

The next constraint dealt with the overall demand for CHAMPUS. This was set with a lower limit as the potential total demand could not be estimated. Also, by establishing the lower limit, the model was forced to assign values to the CHAMPUS variables. Historically, WACH has not been able to provide all the inpatient care required. During FY87, 3429 non availability statements were issued for inpatient care. The 3429 was multiplied by an average length of stay of the days to determine the lower limit of 13,800 bed days. As discussed earlier, the CHAMPUS workload was available only by clinical service and not specific DRG.

Constraint 28. Lower Limit of CHAMPUS Bed Days

$$2.6\ X13 + 1.7\ X22 + 1.8\ X31 + 2.9\ X41 + 3.6\ X42 + 2.4\ X52 + 3\ X53 + 2.4\ X61 + 2.5\ X62 + 2.7\ X71 + 1.9\ X72 + 3.1\ X73 + 4.5\ X83 + 1.9\ X92 + 2.2\ XA1 + 2.3\ XA2 + 4.8\ XA3 + 2.1\ XB1 + 2.8\ XB2 + 4.5\ XB3 + 2.8\ XC1 + 3\ XC2 + 2\ XD1 + 4.7\ XD3 \geq 13,800.$$

Constraints 29 through 49 provide lower limits on the WACH variables. These were established to ensure that particular variables were included in the solution to meet the overall training missions. The right hand side values were determined by using a percentage of FY87 bed days for the selected variables.

<u>Constraint 29.</u> Lower Limit for Y13 Bed Days

$2.5\ Y13 \geq 100$

<u>Constraint 30.</u> Lower Limit for Y22 Bed Days

$2.5\ Y22 \geq 250$

<u>Constraint 31.</u> Lower Limit for Y31 Bed Days

$2.7\ Y31 \geq 300$

<u>Constraint 32.</u> Lower Limit for Y41 Bed Days

$2.7\ Y41 \geq 200$

<u>Constraint 33.</u> Lower Limit for Y42 Bed Days

$3.1\ Y42 \geq 250$

<u>Constraint 34.</u> Lower Limit for Y52 Bed Days

$3.4\ Y52 \geq 300$

<u>Constraint 35.</u> Lower Limit for Y53 Bed Days

$4.2.1\ Y53 \geq 250$

<u>Constraint 36.</u> Lower Limit for Y61 Bed Days

$2.4\ Y61 \geq 200$

<u>Constraint 37.</u> Lower Limit for Y62 Bed Days

$4\ Y62 \geq 200$

<u>Constraint 38.</u> Lower Limit for Y71 Bed Days

$3.2\ Y71 \geq 350$

<u>Constraint 39.</u> Lower Limit for Y73 Bed Days

$4.7\ Y73 \geq 3300$

<u>Constraint 40.</u> Lower Limit for Y83 Bed Days

$5.1\ Y83 \geq 500$

<u>Constraint 41.</u> Lower Limit for Y92 Bed Days

$3.2\ Y92 \geq 150$

<u>Constraint 42.</u> Lower Limit for YA1 Bed Days

$2\ YA1 \geq 100$

<u>Constraint 43.</u> Lower Limit for YA2 Bed Days

$2.7\ YA2 \geq 150$

<u>Constraint 44.</u> Lower Limit for YA3 Bed Days

$5.7\ YA3 \geq 300$

<u>Constraint 45.</u> Lower Limit for YB2 Bed Days

$2.8\ YB2 \geq 130$

<u>Constraint 46.</u> Lower Limit for YB3 Bed Days

$4.7\ YB3 \geq 1500$

<u>Constraint 47.</u> Lower Limit for YC1 Bed Days

$2.9\ YC1 \geq 300$

<u>Constraint 48.</u> Lower Limit for YD1 Bed Days

$1.5\ YD1 \geq 400$

<u>Constraint 49.</u> Lower Limit for YD3 Bed Days

$10\ YD3 \geq 1000$

Analysis of Results

The formulated linear programming model was run using the Computer Models for Management Science (1986) and required 48 iterations to reach the optimal solution within the given constraints. Of the forty-eight variables used in the model, five CHAMPUS variables had a value of greater than zero; while all the Womack variables are included in the final solution. The objective function value was 13,688,624 dollars. The shadow price for the unit change in bed days would cost 330.833 dollars over the range of 35,532.477 or greater. To facilitate the analysis, the variables were discussed by clinical service with Womack variables first followed by the CHAMPUS variables. See Appendix D for computer calculation of the model to include constraints, results, and sensitivity analysis. See Appendix E for a graphic illustration of the results.

Medicine Service

Within the Medicine Service, the Womack variables accounted for 1,042 DRGs for a total of 3,293 bed days and a cost of 1,045,731.20 dollars. This met the lower limit bed constraint of 2,282 with a surplus of 1,011 bed days and the upper limit bed constraint of 6,024 bed days. Medicine nursing hours used were 19,781 with a slack of 1,593 nursing hours. The most restrictive constraint of the Medicine DRG variables were the physician bed days. All 3,293 physician bed days were utilized. The unit change of another bed day in the medicine physician constraint would increase the optimal objective function by $50.83. This shadow price would be valid over the range of 2,282 to 3,621.823 medical bed days.

The variable Y13 (DRG 29, Traumatic Stupor and Coma < 1 Hour, Age 18-69 w/o CC) translated into 60 admissions for a total of 150 bed days and a cost of 42,000 dollars. Variable Y13 would remain in the solution with the value of 60 as long as its objective function coefficient remained at 700 dollars or greater.

Variable Y52 (DRG 143, Chest Pain) represented 88.235 admissions for a total of 300 bed days and a cost of 126,000 dollars. Variable Y52 would remain in the solution with the value of 88.235 as long as its objective function coefficient ranged between 952 or greater. The shadow price for a unit change in bed days of Variable Y52 would cost 140 dollars over the range of 300 to 1643 bed days.

Variable Y53 (DRG 140, Angina Pectoris) represented 59.524 admissions for a total of 25 bed days and a cost of 104,941 dollars. Variable Y53 would remain in the solution with the value of 59.524 as long as its objective function coefficient remains between 1176 or greater. The shadow price for a unit change of Variable Y53 would cost 139.76 dollars over the range of 0 to 528 bed days.

Variable Y62 (DRG 183 Esophagitis, Gastroenteritis and Miscellaneous Digestive Disorders Age 18-69 w/o CC) accounted for

125 admissions for a total of 35 bed days and a cost of 144,750 dollars. Variable Y62 would remain in the solution as long as its objective function coefficient remains between 1027.947 or greater. The shadow price for the additional bed day of Variable Y62 would cost 32.51 dollars over the range of 0 to 1345 bed days.

Variable Y83 (DRG 278, Cellulitis Age 18-69 w/o CC) accounted for 98.039 admissions and 500 medical bed days and a cost of 140,000 dollars. For Variable Y83 to remain in the solution, its objective function coefficient must remain at 1428 dollars or greater.

Variable YC2 (DRG 421, Viral Illness Age > 17) accounted for 344.359 admissions for 1,343 bed days and a cost of 376,040.03 dollars. For Variable YC2 to remain in the solution, its objective function coefficient must not exceed 1092 dollars.

Variable YD1 (DRG 467, Other Factors Influencing Health Factors) represented 266.667 admissions for a total of 400 bed days and a cost of 112,000.14 dollars. For variable YD1 to remain in the solution, its objective function coefficient must remain at 420 dollars or greater.

The CHAMPUS variables that entered the solution were X62 (DRG 183) and X83 (DRG 278). This accounted for 3000 bed days for a total of 1,433,200 dollars. A unit change in CHAMPUS medical bed days would cost 72.50 dollars over the range of 1750 and 10,756 bed days.

The variable X62 represented 700 admissions for a total of 1750 bed days and a cost of 928,200 dollars. Variable X62 with the value of 700 would remain in the objective function as long as its objective function coefficient remained between 1008.333 and 1347.159.

Variable X83 represented 277.778 admissions for a total of 1250 bed days at a cost of 505,000 dollars. The variable X83 would remain in the solution at the value of 277.778 as long as the objective coefficient remained between 1776.914 and 1863.

For the remaining CHAMPUS medical variables, their values would remain zero within the given ranges. Variable X13 (DRG 29) value would remain zero as long as its objective function coefficient remained at 1048.667 dollars or greater. Variable X52 (DRG 143) would remain zero as long as its objective function coefficient remained between 968 dollars or greater. Variable X53 (DRG 140) would remain zero as long as its objective coefficient remained at 1210 dollars or greater. Variable XC2 (DRG421) would remain zero as long as its objective function remained between 1210 dollars or greater. Variable XD1 (DRG 467) would remain zero as long as its objective function value remained at 806.667 dollars or greater. Any changes in the objective function coefficients within the given ranges could only be made to one coefficient without changing the overall objective function value. Changes to more than one objective function coefficient would require rerunning the analysis.

EENT Service

Within the EENT Service, the Womack variables accounted for 211 DRGs for a total of 583 bed days at a cost of 184,122.13 dollars. This met the lower limit bed constraint of 521.95 with a surplus of 61.383 bed days and the upper limit of 1470.5 for a slack of 887.5 bed days. EENT nursing hours used were 1715.69 with a slack of 1309.261 nursing hours. The physician bed days used were 583.333 with a slack of 208.667 bed days.

The variable Y22 (DRG 39, Lens Procedure with or without Vitrectomy) accounted for 100 admissions for a total of 250 bed days at a cost of 86,900 dollars. Variable Y22 would remain in the solution with the value of 100 as long as its objective function coefficient remained at 827.083 dollars or greater. A unit change of another Y22 bed day would cost 16.767 dollars over the range of 188.617 to 458.667 bed days.

The variable Y31 (DRG 55 Miscellaneous Ear, Nose and Throat Procedures; DRG 56, Rhinoplasty) accounted for 111.111 admissions for a total of 333.333 bed days at a cost of 97,222.13 dollars. For variable Y31 to remain in the solution with the value of 111.111, its objective function coefficient must remain at 747.58 dollars or greater. The shadow price of Y31 was 47.193 dollars valid over a range of 244.755 to 487.8 bed days. (Note: Any combination of DRGs 55 and 56 may be used to reach the 111.111 value.)

The CHAMPUS EENT variables accounted for 97.222 DRGs for 175 bed days and a total cost of 108,110.86 dollars. This met the requirement of the lower limit bed constraint of 175. The unit change of a CHAMPUS EENT bed day would cost 286.944 dollars over the range of zero to 10,155.524 bed days.

Only the CHAMPUS Variable X31 (DRG 55 and 56) entered the solution and accounted for the entire 175 bed days and cost of 108,110.86 dollars. The Variable X31 would remain in the solution with the value of 97.222 as long as the objective function coefficient remains between 595.5 and 1786.235 dollars. Again, DRGs 55 and 56 may be used in any combination for the total variable value. Variable X22 (DRG 39) would remain at zero as long as its objective function coefficient remained at 1050.222 dollars or greater.

Pediatrics

Within the Pediatric Service, the Womack variables accounted for 672 DRGs for a total of 1731.03 bed days and a cost of 530,251.54 dollars. This met the lower limit bed capacity with a surplus of 723.633 bed days, while the upper limit bed capacity of 1883.4 has a slack of 152.367. The physician bed days used were also 1731.03 with a slack 809.967 bed days. Pediatric nursing hours were totally consumed and this became the most restrictive constraint of the Pediatric Service. All 3424.77 nursing hours were used and had a shadow price of 41.919 dollars for each unit change in pediatric nursing man hours over the range of 2630.861 to 3654.971 nursing man hours.

Variable Y31 (DRG 70, Otitis Media and URI Age 0-17) accounted for 111.111 admissions and 256 bed days for a total cost of 97,222.13 dollars. For Variable Y31 to remain at 111.111, the objective function coefficient must remain between 747.58 dollars or greater. The shadow price of 47.193 dollars would remain valid for unit change in bed days over the range of 244.755 to 487.8 bed days.

Variable Y41 (DRG 98, Bronchitis and Asthma Age 0-17) accounted for 74.074 admissions for 200 bed days and a cost of 69,111.04 dollars. For variable Y41 to stay in the solution with the value of 74.04, the objective function coefficient must remain between 722.219 dollars or greater. The shadow price for a unit change in bed days for Variable Y41 is 78.067 dollars over a range of zero to 725.381.

Variable Y42 (DRG 91, Simple Pneumonia and Pleurisy Age 0-17) accounted for 80.645 admissions for 250 bed days and a cost of 86,370.80 dollars. For the Variable Y42 to remain in the optimal solution at the value of 80.645, the objective function coefficient must remain above 408.445 dollars. The shadow price for Y42 for each unit change in bed days would be 213.727 dollars over the range of 178.911 to 417.173 bed days.

Variable Y61 (DRG 184, Esophagitis, Gastroenteritis, and Miscellaneous Digestive Disorders Age 0-17) accounted for 302.282 admissions for bed days of 725 at a cost of 194,065.04 dollars.

For the Variable Y61 to stay in the solution at the value of 302.282, the objective function coefficient must remain no greater than 667.821 dollars. The shadow price for Y61 for each unit change in bed days would be zero because of the surplus 525.477 bed days. This would be valid over the range of zero to 725.381 bed days.

Variable YC1 (DRG 422, Viral Illness and Fever of Unknown Origin Age 0-17) represented 103.448 admissions for 300 bed days and a cost of 83,482.54 dollars. For YC1 to remain in the solution with the value of 103.448, the objective function coefficient must remain at 775.809 or greater. The shadow price for each unit change in bed days for Y41 would be zero.

The CHAMPUS Pediatric variables accounted for 3880.773 admissions for 9,255.5224 bed days at 3,005,835.7 dollars. This was a surplus of 6855.523 bed days for a zero shadow price valid up to 9255.523 bed days. The CHAMPUS variable values were concentrated on two out of the five variables.

Variable X31 (DRG 70) represented 97.222 admissions for 175 bed days at a cost of 108,110.86 dollars. The variable X31 would remain in the solution with the value of 97.222 as long as the objective function coefficient remained between 595.5 and 1786.235 dollars.

Variable X61 (DRG 184) accounted for 3783.551 admissions for total bed days of 9080.5224 at a cost of 3,004,139.5 dollars.

Variable X61 would remain in the solution as long as the objective function coefficient remained between 723.36 and 814.313 dollars.

The model concentrated DRGs into the Variable X61 as it had the least costly objective function coefficient of the pediatric CHAMPUS variables. The value for Variable X41 would remain at zero as long as the objective function coefficient was 959.417 dollars or greater. Variable X42 would remain at zero value as long as the objective function coefficient remained at 1191 dollars or greater. Variable XC1 would remain at zero value as only as the objective function coefficient remained between 926.333 dollars or greater.

Surgical Services

For the Surgical Service, the Womack variables represented 540 admissions for 3448 bed days at a cost of 1,089,580.5 dollars. The lower limit bed capacity was exceeded by 2324 bed days while the upper bed capacity was 5577. However, the maximum consumption rate constraint on bed day usage was the physicians with a total of 3448 bed days. A shadow price of 29.43 dollars would result from a unit change in bed days over a range of 2350 to 4025.041 surgical bed days. Nursing man hours had a slack of 6,099.324 man hours and utilized 28,642.124 nursing man hours.

Variable Y62 (DRG 162, Inguinal and Femoral Hernia Procedures Age 18-69 w/o CC) represented 125 admissions for a total of 650 bed days at a cost of 144,750 dollars. For Y62 to remain in the solution with a value of 125, the objective function coefficient must remain between 1027.947 dollars or greater. The shadow price for each unit change in bed days for variable Y62 would be 32.513 dollars over the range of zero to 1344.615 bed days.

Variable Y92 (DRG 339, Testes Procedures, Non-malignancy Age > 17) represented 46.875 admissions for 150 bed days at a cost of 51,187.5 dollars. Variable Y92 would remain in the solution at the value of 46.875 as long as the objective function coefficient was 964.48 dollars or greater. The shadow price of for each unit change in bed days for variable Y92 would be 39.85 dollars over a range of zero to 1248 bed days.

Variable YA1 (DRG 369, Menstrual and Other Female Reproductive System Disorders) accounted for 50 admissions for 100 bed days and 47,500 dollars. For Variable YA1 to remain in the solution with the value of 50, the objective function coefficient value must remain in the range of 602.8 dollars or greater. Variable YA1 had a shadow price of 173.6 dollars for each unit change in bed days over a range of zero to 1198 bed days.

Variable YA2 (DRG 361, Laparoscopy and Incisional Tubal Interruption) represented 55.556 admissions for 150 bed days at a cost of 71,278.35 dollars. For Variable YA2 to remain in the solution, at the value of 55.556, the objective function coefficient would have to remain in the range of 813.78 dollars or greater. Variable YA2 had a shadow price of 173.785 dollars for each unit change of bed days over a range of zero to 1248 bed days.

Variable YA3 (DRG 359, Uterine and Adnexa Procedures for Non Malignancy Age < 70 w/o CC) represented 52.632 admissions for total bed days of 300 at a cost of 142,527.46 dollars. For Variable YA3 to remain in the solution with a value of 52.632, the objective function coefficient would have to remain in the range of 1717.98 dollars or greater. Variable YA3 had a shadow price of 173.688 dollars per unit change of bed days over the range of zero to 1398 bed days.

Variable YD3 (DRG 468, Unrelated OR Procedures) accounted for 209.8 admissions for 2098 bed days at a cost of 632,337.20 dollars. Variable YD3 would remain in the solution with the value of 209.8 as long as the objective function coefficient ranged no greater than 3264.103 dollars. The shadow price for each unit change in bed days for variable YD3 would be zero over the range from zero to 2098 bed days.

The CHAMPUS Surgical Variables accounted for 700 admissions for 1750 bed days at a cost of 928,200 dollars. This met the lower limit bed day requirement which had a shadow price of 127.067 dollars for every unit change in bed days made over a range of zero to 2999.99 bed days.

The CHAMPUS Surgical variables were concentrated on X62 (DRG 162) for 700 admissions at the above rate. For variable X62 to remain in the solution at the value of 700, the objective function coefficient would have to remain in the range of 1008.333 to 1347.159 dollars. Variable X92's value would remain at zero as long as its objective function coefficient ranged from 870.01 dollars or greater. Variable XA1's value would also remain zero as long as the objective function coefficient remained at 1007.38 dollars or greater. Variable XA2's value would remain zero as long as the objective coefficient ranged from 1053.17 dollars or higher. The value for XA3 would remain zero as long as the objective function coefficient was 2197.92 dollars or higher. The final surgical variable XD3 would retain the value of zero as long as the objective function coefficient was between 2152.13 and 4069 dollars.

Orthopedic Service

For the Orthopedic Service, Womack variables represented 1,705.253 admissions for 6510 bed days at a total cost of 1,918,599.5 dollars. The lower bed day limit was met with a surplus of 728.4 bed days and a slack of 2775.6 bed days for the upper limit. However, the consumption of physician bed days reached the maximum level of 6510 bed days. The shadow price for each unit change of physician bed days was 83.333 dollars over the range of 5781.6 to 8395 bed days. Nursing man hours used were 48,948.465 hours with a slack of 1006.035 hours which had a shadow price of zero for the range of 48,948.465 or greater nursing hours.

Variable Y71 (DRG 254, Fractures, Sprains, Strains, and Dislocation of Upper Arm, Lower Leg Except Foot, Age 18-69 w/o CC) represented 109.375 admissions for 350 bed days at a cost of 88,046.88 dollars. For Variable Y71 to remain in the solution with the value of 109.357, the objective function coefficient must remain greater than 792 dollars. The shadow price for each unit change in orthopedic bed days for variable Y71 was a cost of 4.063 dollars over the range of 38.172 to 2310 bed days.

Variable Y72 (DRG 229, Hand or Wrist Procedure, except Major Joint Procedures w/o CC; DRG 232, Arthroscopy) represented 893.75 admissions for 2860 bed days at a cost of 707,850 dollars. For the variable Y72 to remain in the solution with the value of 893.75, the objective function coefficient must remain less than 805 dollars. Any combination of DRGs 229 and 222 may be used to reach the value of 893.75.

Variable Y73 (DRG 219, Lower Extremity and Humerus Procedure Except Hip, Foot, Femur Age > 69 and/or CC; DRG 222, Knee Procedures Age < 70 w/o CC; DRG 231, Local Excision and Removal of Internal Fixation Devices Except Hip and Femur; DRG 234 Other Musculoskeletal System and Connective Tissue OR Procedures Age < 70 w/o CC; DRG 243, Medical Back Problems) represented 702.128 admissions for 3300 bed days at a cost of 1,122,702.7 dollars.

Again, any combination of the Y73 DRGs may be used to reach the total of 702.128 admissions. For Variable Y73 to remain in the solution with the value of 702.128, the objective function coefficient must remain greater than 1163.25 dollars. The shadow price for variable Y73 was 92.713 dollars for each unit change of bed days over a range of zero to 3474.335.

The CHAMPUS Orthopedic Variable represented 333.333 admissions for a total of 900 bed days at a cost of 384,666.28 dollars. This met the lower limit for 900 bed days with a shadow price of 96.574 dollars over the range of zero to 7755.523 bed days. The model concentrated on placing all the admissions in the variable X71 which was the least costly and least resource intensive. Variable X71 accounted for 333.333 admissions at the above rate. For variable X71 to remain in the solution at the value of 333.333, the objective function coefficient must remain between 893.25 and 1563.387. Variable X72 would remain at zero value as long as the objective function coefficient was greater than 812.074 dollars. Variable X73 would remain at zero value if the objective function coefficient remained greater than 1324.963 dollars.

Obstetric Services

For the Obstetrical Service, the Womack variables represented 2202 admissions for 6956 bed days at a cost of 1,605,174.1 dollars. The lower bed day limit was met with a surplus of 72.101 bed days and a slack of 1439 bed days for the upper limit. However, bed days reached maximum consumption under the physician bed day constraint. The shadow price of 104.971 dollars was listed for each unit of change of physician bed days over the range from 6883.899 to 8395 bed days. Nursing man hours used were 22927.537 with slack of 8143.463 hours which had a shadow price of zero over the range of 22,927.537 and above.

Variable YB1 (DRG 373, Vaginal Delivery w/o Complicating Diagnosis; DRG 379, Threatened Abortion; DRG 381, Abortion with D&C, Aspiration Curettage, or Hysterotomy; DRG 383, Other Antepartum Diagnoses with Medical Complications, DRG 384, Other Antepartum Diagnoses w/o Medical Complications) represented 1836.552 admissions for 5326 bed days at a cost of $1,202,941.60 dollars. For variable YB1 to remain in the solution with the value of 1836.552, the objective function coefficient must remain no greater than 789.787 dollars.

Variable YB2 (DRG 374, Vaginal Delivery with Sterilization and/or D&C) represented 46.429 admissions for 130 bed days and a cost of 38,721.79. For variable YB2 to remain in the solution with the value of 46.429, the objective function coefficient must be greater than 632.414 dollars. The shadow price for Variable YB2 for each unit change of bed days was 71.995 dollars over the range of zero to 2325.207 bed days.

Variable YB3 (DRG 370, Cesarean Section with CC DRG 371, Cesarean Section w/o CC; DRG 372, Vaginal Delivery with

Complicating Diagnoses) represented 319.149 admissions for 1500 bed days at a cost of 408,510.72 dollars. For Variable YB3 to remain in the solution with the value of 319.149, the objective function coefficient must be greater than 1061.552. The shadow price for variable YB3 for each unit change of bed days was 46.478 dollars over a range of less than 2358.122 bed days.

The CHAMPUS Obstetric Variables account for 2,857.143 admissions for 6000 bed days at a cost of 2,582,857.3 dollars. This met the lower limit for bed days and established a shadow price of 99.643 dollars for each unit change in OB CHAMPUS bed days over the range of zero to 13,755.523 bed days.

The CHAMPUS Obstetric variables were concentrated on XB1 for 2,857.143 admissions at the above rate. For variable XB1 to remain in the solution with the value of 2,857.143, the objective function coefficient would remain in the range of 694.75 to 1051.867 dollars. Variable XB2 would remain at zero value if the objective function coefficient was 1205.333 dollars or greater. Variable XB3 would remain at zero value if the objective function coefficient was 1937.143 dollars or greater.

CONCLUSION AND RECOMMENDATION

Conclusion

The formulated management model determined the optimal mix of inpatient services for selected DRGs at Womack Army Community Hospital, given the constraints for available bed days, physician staffing, nursing personnel staffing, and estimated demand. Womack physician bed days are the limiting consumption factor in the areas of Medicine, Surgery, Orthopedics and Obstetrics, while nursing man hours are fully consumed on the Pediatric Service. EENT Service is the only area in which slack exists in all Womack constraints. Clinical and administrative managers may utilize this knowledge to develop plans for inpatient services for the Fort Bragg patient population. Resource managers may also utilize this knowledge to more efficiently manage the CHAMPUS costs within the catchment area while continuing to meet the fiscal, training, and quality of care responsibilities of WACH.

On another level, managers have the ability to adjust any one of the constraints because of changes in the availability of resources. The sensitivity analysis supplies a mathematical determination of the effect on the overall objective function as a result of a change in a constraint. The ranges for the variable values provide a flexibility within which the manager can make adjustments.

The addition of a physician in either Medicine, Surgery, Orthopedic, and Obstetrics (all maximized constraints) can be calculated both in terms of cost and use of other resources. In the same fashion, the addition of nursing resources to the

Pediatric unit would cost 40.92 dollars per unit change in nursing hours over the range of 2630.861 to 3645.971 nursing man hours. However, it would be of no use to add more beds or physicians to the Pediatric service without a change in the nursing personnel staffing.

The EENT Service does have slack in all constraints. Slack represents available resources; therefore, changes can be planned and the cost associated with the proposed changes estimated prior to actual implementation. Approximately 200 physician bed days are available for use at zero cost for physician time. However, the addition of bed days through increased admissions will increase the use of nursing hours. Up to 1309 nursing hours can be added at no cost. It is important to remember that shadow prices are valid for only single changes.

It was noted earlier that the MEPRS system spreads fixed costs across all expense accounts and that the hospital has high fixed costs. Five out of six Womack Categories had slack in the area of nursing man hours which were based on a monthly average collected for a one-year period. The nursing staff is a fixed cost that must be paid whether the workload is high or low. Holidays and summers are periods of low workload, yet the actual nursing staff remains constant. Thus, these fluctuations must be also considered when making resource decisions.

Overall, the management model presents a realistic optimization of selected DRGs. The cost associated with changing resources can be easily calculated. Perhaps most significant is the fact that resources and their consumption rates are quantified. Quality and standards of care are incorporated into resource constraints so that the individuals developing the constraints have flexibility within the established ranges by the sensitivity analysis. The model presents a timely, flexible, and quantitative means of determining resource allocation.

Recommendations

Recommendations based on the management model require both clinical and administrative involvement. Health care administrators cannot operate in a vacuum without clinician input and support. In turn, the clinical providers must be cognizant and receptive to management techniques that enhance the art of patient care.

The first major recommendation focuses on the use of the management model which optimized the use of constrained resources as a resource base. The clinical department or service chiefs may utilize this data to plan admissions as well as training requirements for physicians and residents. The presence of the cost coefficients allows a value to be placed on each of the resources being used.

The nursing department may utilize the nursing man hours derived from the WMSN to plan and adjust staffing on an operational level. This WMSN data can be combined with the additional resource constraints presented by the model to collaborate with the command group in the strategic planning for the hospital. There is also potential for part-time scheduling to be used for high volume, high resource use diagnoses such as elective surgery schedules. The use of part-time nursing staff in this situation may facilitate the use of bed days and physician resources more efficaciously. On the Pediatric Service, nursing hours have been maximized for the selected DRGs while slack exists in bed days and physicians. The addition of nursing personnel to care for elective short stay surgeries would utilize the slack resources at an identified cost in nursing man hours.

Next, it is recommended that, in the development of this model and future models, management not be lured to focusing only on the low cost/low resource use DRGs. The elements of quality of care and maintenance of training program requirements must be considered in order to provide a balanced hospital experience for students and residents.

It is also recommended that specific high cost DRGs be carefully scrutinized and studied as to their cost components. Do purchasing policies, types of equipment, or other labor factors have a significant cost impact on the DRG? A resource intensive DRG may be less costly after review through management changes that do not affect the overall quality of care.

Another recommendation is that the hospital command elicit from the higher headquarters timely, accurate, and meaningful information from the various information management and support systems. It was obvious from this study that many of the existing information management systems did not collect data in a useful, meaningful manner. Specific comments to HSC would focus on the need for MEPRS to collect information by DRG as well as the timely evaluation of facility DRG analysis. Meaningful information must also be supplied from OCHAMPUS.

The hospital command must elicit from its own staff elements a commitment to quality management, both clinically and administratively. Education of the staff is imperative not only in the area of cost control, but also with documentation. The DRGs were the basis of the variables used in this study and they will soon be the basis upon which resource allocations are made. Accuracy in documentation by physicians as well as accuracy in coding by medical records personnel is vital. Follow up to determine the effectiveness of the educational programs is a necessity in the evaluation process.

This recommendation also emphasizes the need for clinical and administrative managers to work closely together in the area of utilization review for development of pre-admission screening as well as concurrent reviews. Length of stay and utilization of resources are key components to the overall cost of care.

For further study and application, it is recommended the model be developed for each hospital service. A service-specific model would permit the inclusion of all applicable DRGs and would also permit more specific constraints to be applied. This would be most applicable for the surgical services where many patients can be scheduled on an elective basis. It would also permit redistribution of resources where slack exists and would allow a cost to be applied to the resource changes prior to any actual movement.

With further development of the linear programming model for all hospital services, all subsequent DRGs and accompanying constraints, it is recommended that an interactive linear programming package be purchased. A package such as LINDO (Trademark) can be used on a mainframe or personal computer to solve problems with over a thousand variables and as many constraints (Taylor 1986, 101).

The challenge of providing health care in the face of rising costs and limited resources is indeed a management challenge to all. The DRGs provide a mechanism for comparison between the military health care system and CHAMPUS. The development of a management model that utilizes available knowledge and hospital resources to optimize its services for the reduction of overall cost of government health care is certainly a relevant and useful management tool.

TABLE A

ESTIMATED FORT BRAGG CATCHMENT AREA

POPULATION FOR FY 87

TABLE A

ESTIMATED FORT BRAGG CATCHMENT AREA POPULATION
FOR FY87

Active Duty	45,699
Dependents of Active Duty	52,102
Retirees	13,174
Dependents of Retirees	16,208
Survivors	3,728
Eligible but not Enrolled in DEERS	1,125
	132,036

SOURCE: United States. Assistant Secretary of Defense (Health Affairs). 1988. Resource Analysis and Programming Systems (RAPS): Fort Bragg Catchment Area. FY 87 Projection Based on FY 86 Baseline, 25 April.

TABLE B

CHAMPUS COST AND WORKLOAD REPORT

FOR WACH/FORT BRAGG BY CATEGORY

TABLE B

CHAMPUS COST AND WORKLOAD REPORT FOR WACH/FORT BRAGG BY CATEGORY
OCTOBER 1986 THROUGH SEPTEMBER 1987

HIGH VOL (ADM)		TOTAL GOVT HIGH COST ($)		HIGH GOVT COST/ADM ($)		HIGH GOVT COST/DAY ($)	
Obstetrics	(1873)	Obstetrics	(3,729,634)	Spec Ped	(14,615.40)	Spec Peds	(797.11)
Psych Gp I	(318)	Psych Gp I	(2,817,334)	Psych Gp II	(11,173.84)	ENT	(734.05)
Gynecology	(238)	Spec Peds	(2,221,541)	Psych Gp I	(8,859.54)	Cardiology	(617.01)
Cardiology	(232)	Psych Gp II	(1,966,596)	Dermatology	(4,841.17)	Dermatology	(592.80)
Gen Surg	(219)	Cardiology	(940,328)	Neurology	(4,368.26)	Obstetrics	(589.67)
Psych Gp II	(176)	Gynecology	(575,403)	Inf Disease	(4,287.86)	Pulm/Resp	(577.92)
Spec Peds	(152)	Neurology	(497,982)	Cardiology	(4,053.14)	Other	(577.08)
Ortho	(128)	Gen Surg	(482,859)	Endocrinology	(3,929.44)	Inf Dis	(535.98)
Neurology	(114)	Ortho	(472,046)	Adv Reactions	(3,877.45)	Urology	(533.18)
Gastroenterology	(111)	Pulm/Resp	(398,763)	Hematology	(3,787.53)	Adv React	(526.57)
Pulm/Resp	(109)	Neuro Surg	(221,663)	Ortho	(3,687.86)	Gynecology	(514.67)
				Pulm/Resp	(3,658.38)		

SOURCE: CHAMPUS Cost and Workload Report No: HR 85-007, 1-11-88.

TABLE C

SELECTED DRGs FOR WACH BY DISPOSITION

AND LENGTH OF STAY

TABLE C

SELECTED DRGs FOR WACH BY DISPOSITION
AND LENGTH OF STAY

CODE	DIAGNOSIS RELATED GROUP	BED DAYS AT BRAGG DSPO	MEAN	TOTAL
029	Traumatic Stupor & Coma, Coma < 1 hr Age 18-69 w/o CC	71	2.5	179
039	Lens Procedures with or without Vitrectomy	144	2.5	354
055	Miscellaneous Ear, Nose & Throat Procedures	120	3.0	362
056	Rhinoplasty	92	2.9	268
070	Otitis Media & URI Age 0-17	124	2.3	282
091	Simple Pneumonia & Pleurisy Age 0-17	97	3.1	297
098	Bronchitis & Asthma Age 0-17	107	2.7	286
140	Angina Pectoris	94	4.2	392
143	Chest Pain	148	3.4	509
162	Inguinal & Femoral Hernia Procedures, Age 18-69 w/o CC	182	5.2	947
183	Esophagitis, Gastroent & Misc Digest Disord w/o CC	198	2.8	554
184	Esophagitis, Gastroent & Misc Digest Disord Age 0-17	103	2.4	251
219	Lower Extrem & Humer Proc Ex Hip, Foot, Femur Age 18-69 w/o CC	179	5.5	991
222	Knee Procedures Age <70 w/o CC	217	4.8	1033
225	Foot Procedures	136	3.1	418
227	Soft Tissue Procedures Age <70 w/o CC	63	4.6	291
229	Hand or Wrist Proc Except Major Joint Proc, w/o CC	139	2.7	381
231	Local Excision & Removal of Int Fix Devices	343	3.4	1182
232	Arthroscopy	153	3.6	554
234	Other Musculoskelet Sys & Conn Tiss O.R. Proc Age < 70 w/o CC	56	4.1	229
243	Medical Back Problems	290	7.3	2106
254	Fx, Sprn, Strn & Disl of Uparm, Lowleg Ex Foot Age 18-69 w/9o CC	116	3.2	367
278	Cellulitis Age 18-69 w/o CC	102	5.1	523
339	Testes Procedures, Non-Malignancy Age > 17	109	3.2	347
359	Uterine & Adnexa Proc for Non-Malignancy Age <70 w/o CC	89	5.7	511
361	Laparoscopy & Incisional Tubal Interruption	62	2.7	165
369	Menstrual & Other Female Reproductive System Disorders	61	2.0	122
370	Cesarean Section with CC	310	5.1	1580
371	Cesarean Section w/o CC	112	4.9	554
372	Vaginal Delivery with Complicating Diagnoses	99	4.1	403
373	Vaginal Delivery w/o Complicating Diagnoses	1457	2.9	4265
374	Vaginal Delivery w/Sterilization and/or D&C	58	2.8	165
379	Threatened Abortion	261	1.5	388
381	Abortion with D&C, Aspiration Curettage, or hysterotomy	195	1.4	266

CODE	DIAGNOSIS RELATED GROUP	BED DAYS AT BRAGG DSPO	MEAN	TOTAL
383	Other Antepartum Diagnoses with Medical Complications	198	2.7	531
384	Other Antepartum Diagnoses w/o Medical Complications	176	2.5	432
421	Viral Illness Age >17	92	3.9	359
422	Viral Illness & Fever of Unknown Origin Age 0-17	116	2.9	337
467	Other Factors Influencing Health Status	1108	1.5	1627
468	Unrelated Operating Room Procedures	126	10.0	1259

TABLE D

VARIABLE IDENTIFIER TABLE

TABLE D

VARIABLE IDENTIFIER TABLE

i	j: 1 (Low)		2 (Med)		3 (High)			
1					#29	.7013		
2			#39	.6953				
3	#55	.4944						
	#56	.4797						
	#70	.4011						
4	#98	.4954	#91	.6013				
5			#143	.6368	#140	.8066		
6	#184	.3272	#162	.5364				
			#183	.5569				
7	#254	.4756	#229	.6324	#219	1.0774	#231	.8560
			#232	.6903	#222	.8376	#234	.9846
					#225	.7178		
					#227	.7301	#243	.7163
8					#278	.7481		
9			#339	.5752				

i = DRG Category (1...9, A...D)
j = Weight (intensity) (1,2,3)

i \ j	1 (Low)		2 (Med)		3 (High)	
A	#369	.4227	#361	.6857	#359	.9793
B	#373 #379 #381 #383 #384	.4649 .3202 .3639 .3547 .3602	#374	.6705	#370 #371 #372	1.0834 .8984 .8059
C	#422	.4115	#421	.5340		
D	#467	.3411			#468	1.6771

1 - Diseases & Disorders (D&D) of Nervous System
2 - D&D of Eye
3 - D&D of ENT
4 - D&D of Respiratory System
5 - D&D of Circulatory System
6 - D&D of Digestive System
7 - D&D of Musculoskeletal System & Connective Tissue
8 - D&D of Skin/Subcutaneous Tissue & Breast
9 - D&D of Male Reproductive System
A - D&D of Female Reproductive System
B - Pregnancy, Childbirth & Puerperium
C - D&D of Blood & Blood Forming Organs & Immunologic Disorders
D - Factors Influencing Health Status and Other Contacts w/Health Services

TABLE E

CHAMPUS REIMBURSEMENT FOR SELECTED DRGs

TABLE E

CHAMPUS REIMBURSEMENT FOR
SELECTED DRGs
(Effective for discharges occuring after 1 March 1988)

DRG	WEIGHT					REIMBURSEMENT
29	.7013	x	2426.17	=		$1701.47
39	.6953	x	2426.17	=		$1686.92
55	.4944	x	2426.17	=		$1199.50
56	.4797	x	2426.17	=		$1163.84
70	.4011	x	2426.17	=		$ 973.14
91	.6013	x	2426.17	=		$1458.86
98	.4954	x	2426.17	=		$1201.92
140	.8066	x	2426.17	=		$1956.95
143	.6368	x	2426.17	-		$1544.99
162	.5364	x	2426.17	=		$1301.40
183	.5569	x	2426.17	=		$1351.13
184	.3272	x	2426.17	=		$ 793.84
219	1.0774	x	2426.17	=		$2613.96
222	.8376	x	2426.17	=		$2032.16
225	.7178	x	2426.17	=		$1741.51
227	.7308	x	2426.17	=		$1773.05
229	.6324	x	2426.17	=		$1534.31
231	.8560	x	2426.17	=		$2076.80
232	.6903	x	2426.17	=		$1674.79
234	.9846	x	2426.17	=		$2388.81
243	.7163	x	2426.17	=		$1737.87
254	.4756	x	2426.17	=		$1153.89
278	.7481	x	2426.17	=		$1815.02
339	.5752	x	2426.17	=		$1395.53
359	.9793	x	2426.17	=		$2375.95
361	.6857	x	2426.17	=		$1663.62
369	.4227	x	2426.17	=		$1025.54
370	1.0834	x	2426.17	=		$2628.52
371	.8984	x	2426.17	=		$2179.67
372	.8059	x	2426.17	=		$1955.25
373	.4649	x	2426.17	=		$1127.93
374	.6705	x	2426.17	=		$1626.75
379	.3202	x	2426.17	=		$ 776.86
381	.3639	x	2426.17	=		$ 882.88
383	.3547	x	2426.17	=		$ 860.56
384	.3602	x	2426.17	=		$ 873.91
421	.5340	x	2426.17	=		$1295.57
422	.4115	x	2426.17	=		$ 998.37
467	.3411	x	2426.17	=		$ 827.57
468	1.6771	x	2426.17	=		$4068.93

TABLE F

FY 87 MEPRS INPATIENT CARE FINAL OPERATING

EXPENSE ACCOUNTS

TABLE F
FY87 MEPRS INPATIENT CARE
FINAL OPERATING EXPENSE ACCOUNTS
(WITHOUT CLINICIAN SALARIES)

	EXP($)	OCC BED DAYS	COST/ OCC BED DAYS($)	TOTAL DISP	COST/ DISP($)
Internal Med	3,105,914	11,092	280.01	2,059	1,508.46
Cardiology	325,916	921	353.87	298	1,093.68
Coronary Care	647,015	1,541	419.87	183	3,535.60
Gastroenterology	54,528	204	267.29	90	605.87
Intensive Care (Med)	414,927	918	451.99	92	4,510.08
Oncology	230,961	815	283.39	172	1,342.80
Dermatology	31,224	153	204.08	23	1,357.57
Hematology	26,062	106	245.87	29	898.69
Pulm/Upper Resp	108,185	313	345.64	46	2,351.85
Gen Surgery	2,727,876	9,050	301.42	1,697	1,607.47
Int Care (Surg)	207,434	778	266.62	49	4,233.35
Ophthalmology	395,205	1,137	347.58	432	914.83
Oral Surgery	382,927	811	472.16	138	2,774.83
Otorhinolaryngology	923,263	2,745	336.34	917	1,006.83
Urology	775,254	2,272	341.22	632	1,226.67
Gynecology	696,515	1,466	475.11	523	1,331.77
Obstetrics	3,020,813	10,148	297.68	3,860	782.59
Pediatrics	1,007,950	3,622	278.29	1,165	865.19
Nursery	1,025,516	6,268	163.61	2,001	512.50
Ortho	3,129,704	12,442	251.54	2,429	1,288.47
Podiatry	184,199	630	292.38	207	889.95
Combined	$3,313,903	13,072	$253.51	2,636	$1,257.17
Psych	$ 885,756	3,503	$252.86	451	$1,963.98

Time Period Covered: 1 October 1986 - 30 September 1987

TABLE G

WOMACK DRG COSTS BASED ON FY 87 MEPRS

TABLE G

WOMACK DRG COSTS
Based on FY87 MEPRS

DRG	N	COST FACTOR		AVG LOS		AVG COST/ DISCHARGE
29	71	280.01	x	2.5	=	700.03
39	144	347.58	x	2.5	=	868.95
55	120	336.34	x	3.0	=	1009.02
56	92	336.34	x	2.9	=	975.39
70	124	278.29	x	2.3	=	640.07
91	97	345.64	x	3.1	=	1071.48
98	107	345.64	x	2.7	=	933.23
140	94	419.87	x	4.2	=	1763.45
143	148	419.87	x	3.4	=	1427.56
162	182	301.42	x	5.2	=	1567.38
183	198	267.29	x	2.8	=	748.41
184	103	267.29	x	2.4	=	641.50
219	179	251.45	x	5.5	=	1383.47
222	217	251.54	x	4.8	=	1207.39
225	136	292.38	x	3.1	=	906.38
227	63	251.54	x	4.6	=	1157.08
229	139	251.54	x	2.7	=	679.16
231	343	251.54	x	3.4	=	855.24
232	153	251.54	x	3.6	=	905.54
234	56	251.54	x	4.1	=	1031.31
243	290	251.54	x	18.5	=	4653.49
254	116	251.54	x	3.2	=	804.93
278	102	280.01	x	5.1	=	1428.05
339	109	341.22	x	3.2	=	1091.90
359	89	475.11	x	5.7	=	2708.13
361	62	475.11	x	2.7	=	1282.80
369	61	475.11	x	2.0	=	950.22
370	310	297.68	x	5.1	=	1518.17
371	112	297.68	x	4.9	=	1458.63
372	99	297.68	x	4.1	=	1220.49
373	1457	297.68	x	2.9	=	863.27
374	58	297.68	x	2.8	=	833.50
379	261	297.68	x	1.5	=	446.52
381	195	297.68	x	1.4	=	416.75
383	198	297.68	x	2.7	=	803.74
384	176	297.68	x	2.5	=	744.20
391	1701	163.61	x	3.0	=	490.83
421	92	280.01	x	3.9	=	1092.04
422	116	278.29	x	2.9	=	807.04
467	1108	280.01	x	1.5	=	420.02
468	126	301.42	x	10	=	3014.20

APPENDIX A

FORMULATION OF WACH BED CAPACITY CONSTRAINTS:

UPPER AND LOWER LIMIT

APPENDIX A

FORMULATION OF WACH BED CAPACITY CONSTRAINTS: UPPER AND LOWER LIMIT

DEPARTMENT	VARIABLE	FY87 BED DAYS	TOTAL AVAIL BED DAYS
MEDICINE	Y13	179	51 x 365 = 18,615
	Y52	392	
	Y53	509	
	Y62	554	
	Y83	523	
	YC2	359	
	YD1	1627	

4143 in FY87 or 22.26% of available medical bed days.

Lower limit = 2282 (12.26%)
Upper limit = 6024 (32.26%)

DEPARTMENT	VARIABLE	FY87 BED DAYS	TOTAL AVAIL BED DAYS
EENT	Y22	354	13 x 365 = 4,745
	Y31	362	
		268	

984 in FY87 or 21% of available EENT bed days.

Lower limit = 521.95 (11%)
Upper limit = 1470.95 (31%)

DEPARTMENT	VARIABLE	FY87 BED DAYS	TOTAL AVAIL BED DAYS
PEDIATRICS	Y31	282	12 x 365 = 4380
	Y41	286	
	Y42	297	
	Y61	251	
	YC1	337	

1453 in FY87 or 33% of available bed days

Lower limit = 1007.4 (23%)
Upper limit = 1883.4 (43%)

NOTE: The beds available on the Pediatrics Ward have been decreased to 12 rather than 35 to more accurately reflect the current situation.

DEPARTMENT	VARIABLE	FY87 BED DAYS	TOTAL AVAIL BED DAYS
SURGERY	Y62	947	61 x 365 = 22,265
	Y92	347	
	YA1	122	
	YA2	165	
	YA3	511	
	YD3	1259	

3351 in FY87 or 15.05% of available Surgical bed days.

Lower Limit = 1124 (5.05%)
Upper Limit = 5577 (25.05%)

DEPARTMENT	VARIABLE	FY87 BED DAYS	TOTAL AVAIL BED DAYS
ORTHOPEDICS	Y71	367	48 x 365 = 17,520
	Y72	381	
		554	
	Y73	991	
		1033	
		418	
		291	
		1182	
		229	
		2106	

7552 in FY 87or 43% of available Orthopedic bed days.

Lower Limit = 5781.6 (33%)
Upper Limit = 9285.6 (53%)

DEPARTMENT	VARIABLE	FY87 BED DAYS	TOTAL AVAIL BED DAYS
OBSTETRICS	YB1	4265	23 x 365 = 8395
	YB2	388	
		266	
	YB3	531	
		432	
		165	
		1580	
		554	
		403	

8584 in FY 87 or 1.02% of available OB bed days

Lower Limit = 6883.9 (82%)
Upper Limit = 8395 (100%)

APPENDIX B

FORMULATION OF PHYSICIAN CONSTRAINTS

APPENDIX B
FORMULATION OF PHYSICIAN CONSTRAINTS

The Physician Constraints are based on the JHCMS and the average assigned physicians at WACH.

<u>Medicine</u>

Internists = 95 Inpatient bed days/month

95 x 7 (assigned) = 665 bed days/month x 12 = 7980 Bed Days

<u>Family Practice</u>

28 Residents

15 Staff	8 Faculty 7 Support	=	45 Inpatient Bed Days/ Month

FP Staff 15 x .25 = 3.75 x 45 = 68.75/month x 12 = 2025
FP Residents 28 x .40 = 11.2 x 45 = 504.00/month x 12 = <u>6048</u>

16053 Bed Days Available

$$\frac{\text{Bed Days Evaluated}}{\text{Total Med Dx Bed Days}} = \frac{4143}{20199} = \frac{x}{16053} = 3292.6174$$

= 3293 Bed Days for Medical Variables

Source: 6040 Family Practice <u>JHCMS</u>, 1988
6050 Internal Medicine <u>JHCMS</u>, 1988

EENT

Opth	30 Inpatient Days	x	2	Physicians	= 60 x 12 =	720
ENT	75 Inpatient Days	x	2	Physicians	= 150 x 12 =	1800
						2520 Bed Days Available

$$\frac{\text{EENT Bed Days Evaluated}}{\text{Total EENT Bed Days}} \quad \frac{984}{3130} = \frac{X}{2520} = 792.23$$

792.23 Bed Days for EENT Variables

Source: 6140 Ophthalmology *JHCMS*, 1988
6160 Otolaryngalogy *JHCMS*, 1988

PEDIATRICS

70 Inpatient Days x 5 physicians = 350 x 12 = 4200 bed days available

$$\frac{\text{Peds Bed Days Evaluated}}{\text{Total Peds Bed Days}} \quad \frac{1453}{2402} = \frac{x}{4200} = 2541$$

2541 Bed Days for Pediatric Variables

Source: 6070 Pediatrics *JHCMS*, 1988

SURGEONS

Urology	= 75 Inpatient Days	x 1 physician	=	75
General Surgery	= 190 Inpatient Days	x 5 physicians	=	950
Family Practice Res	= 45 Inpatient Days	x 3 physicians	=	135
Gynecology	= 75 Inpatient Days	x 1 physician	=	75
				1235
				Bed Days Available

Surgical Bed Days Evaluated / Total Surgical Bed Days

$$\frac{3351}{14492} = \frac{x}{14820} = 3448$$ Bed Days for Surgical Variables

SOURCE: 6130 Obstetrics and Gynecology JHCMS, 1988
6180 Surgery JHCMS, 1988
6200 Urology JHCMS, 1988

ORTHOPEDICS

125 Inpatient Days x 7 Assigned = 875 x 12 = 10,500 Bed Days Available

Ortho Bed Days Evaluated / Total Ortho Bed Days

$$\frac{7552}{12181} = \frac{x}{10500} = 6510$$ Bed Days for Orthopedic Variables

Source: 6150 Orthopedic Surgery JHCMS, 1988

OBSTETRICS

15 births/month x 6 (physicians)	=	90
FP Residents & Staff	=	83
		172.5 births/month
	x	3.5 LOS
		603.75 x 12 = 7245 Bed Days Available

$$\frac{\text{OB Bed Days Evaluated}}{\text{Total OB Bed Days}} \quad \frac{8584}{8940} = \frac{X}{7245} = 6956 \text{ Bed Days for OB Variables}$$

Source: 6130 Obstetrics and Gynecology JHCMS, 1988

APPENDIX C

FORMULATION OF NURSING PERSONNEL CONSTRAINTS

APPENDIX C

FORMULATION OF NURSING PERSONNEL CONSTRAINTS

DEPT	VARIABLE	WORKLOAD FACTOR		LENGTH OF STAY				# DISP		
Medicine	Y13	10.57	x	2.5	=	26.4250	x	71	=	1876
	Y52	4.843	x	3.4	=	16.4662	x	148	=	2437
	Y53	10.57	x	4.2	=	44.3940	x	94	=	4173
	Y62	4.843	x	2.8	=	13.552	x	198	=	2683
	Y83	10.57	x	5.1	=	53.907	x	102	=	5498
	YC2	4.843	x	3.9	=	18.888	x	92	=	1738
	YD1	1.541	x	1.5	=	2.3115	x	1108	=	2561

Total Earned Man Hours for these Variables 20966

Ward 8B 3502 Earned Man Hours by WMSN
Ward 7B 4285 Earned Man Hours by WMSN

7787 Earned Man Hours/Month x 12 = 93,444 Earned Man Hours/Year

$\frac{20,966}{93,444}$ = 22.44% of Total Earned Man Hours for 22.26% of available medical bed days

Lower limit = 11,549.68 (12.36% of total earned man hours)
Upper limit = 30,388.80 (32.52% of total earned man hours)

Ward 8B total actual hours worked by MEPRS = $\frac{32,856}{12}$ = 2738/mon

Ward 7B total actual hours worked by MEPRS = $\frac{32,866}{12}$ = 2738.83/mon

Actual Hours Worked

8B	2738	x	12	=	32,856
7B	2738.38	x	12	=	32,866

65,722 Total Actual Hours Worked

$\frac{\text{Actual Hours}}{\text{Earned Hours}}$ $\frac{65,722}{93,444}$ = 70.33%

Lower Limit (11,549.68 X 70.33) = 8122.89 Nursing Man Hours

Upper Limit (30,388.80 x 70.33%)= 21,373.36 Nursing Man Hours

DEPT	VARIABLE	WORKLOAD FACTOR		LENGTH OF STAY				# DISP		
PEDIATRICS	Y31	1.511	x	2.3	=	3.4753	x	124	=	430.9372
	Y41	1.511	x	2.7	=	4.0797	x	107	=	436.5279
	Y42	4.749	x	3.1	=	14.7219	x	97	=	1428.0243
	Y61	1.511	x	2.4	=	3.6264	x	103	=	373.5192
	YC1	1.511	x	2.9	=	4.3819	x	116	=	508.3004

Total Earned Man Hours for these Variables 3177.309

Ward 3A 3482 Earned Hours/Month x 12 = 41784 Earned Man Hours/Year

$\frac{3177}{41784}$ = 7.6% of Total Earned Man Hours for 33% of available Pediatric bed days.

Lower Limit = 2329.7745 (5.57% of total earned man hours)
Upper Limit = 4353.89 (10.42% of total earned man hours)

3A total actual hours worked by MEPRS = $\frac{32,869}{12}$ = 2739.08

Actual Hours / Earned Hours $\frac{32,869}{41,784}$ = 78.66%

Lower Limit (2329.7745 x 78.66%) = 1832.60 Nursing Man Hours.

Upper Limit (4353.89 x 78.66%) = 3424.77 Nursing Man Hours.

DEPT	VARIABLE	WORKLOAD FACTOR		LENGTH OF STAY				# DISP		
PEDIATRICS	Y31	1.511	x	2.3	=	3.4753	x	124	=	430.9372
	Y41	1.511	x	2.7	=	4.0797	x	107	=	436.5279
	Y42	4.749	x	3.1	=	14.7219	x	97	=	1428.0243
	Y61	1.511	x	2.4	=	3.6264	x	103	=	373.5192
	YC1	1.511	x	2.9	=	4.3819	x	116	=	508.3004

Total Earned Man Hours for these Variables 3177.309

Ward 3A 3482 Earned Hours/Month x 12 = 41784 Earned Man Hours/Year

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3A total actual hours worked by MEPRS = $\frac{32,869}{12}$ = 2739.08

$$\frac{\text{Actual Hours}}{\text{Earned Hours}} \quad \frac{32,869}{41,784} = 78.66\%$$

Lower Limit (2329.7745 x 78.66%) = 1832.60 Nursing Man Hours.

Upper Limit (4353.89 x 78.66%) = 3424.77 Nursing Man Hours.

DEPT	VARIABLE	WORKLOAD FACTOR		LENGTH OF STAY				# DISP		
SURGERY	Y62	4.843	x	2.8	=	13.5604	x	198	=	2684.9592
	Y92	4.843	x	3.2	=	15.4976	x	109	=	1689.2384
	YA1	1.541	x	2.0	=	3.082	x	61	=	191.084
	YA2	4.843	x	2.7	=	13.0761	x	62	=	810.7182
	YA3	10.57	x	5.7	=	60.249	x	89	=	5362.161
	YD3	10.57	x	10.0	=	105.79	x	126	=	13318.20

Total Earned Man Hours for these Variables 24056.36

8A = 3819 Earned Man Hours by WMSN
2B = 3557 Earned Man Hours by WMSN

7376 x 12 = 88,512 Earned Man Hours/Year

$\frac{24,056.36}{88,512}$ = 23.26% of total Earned Man Hours for 15.05% of Available Surgical bed days

Lower Limit = 8072.47 (9.12% of total earned man hours)
Upper Limit = 40042.65 (45.24% of total earned man hours)

2A Total actual hours worked by MEPRS $\frac{40,517}{12}$ = 3376.42

2B Total actual hours worked by MEPRS $\frac{36,277}{12}$ = 3023.08

2A 40,517
2B 36,277

76,794 Total Actual Hours Worked

Actual Hours / Earned Hours $\frac{76,794}{88,512}$ = 86.76%

Lower Limit (8072.47 x 86.76%) = 7003.76 Nursing Man Hours

Upper Limit (40,042.65 x 86.76%) = 34,741.45 Nursing Man Hours

DEPT	VARIABLE	WORKLOAD FACTOR		LENGTH OF STAY				# DISP		
OBSTETRICS	YB1	1.556	x	2.9	=	4.5124	x	1457	=	6574.57
		1.556	x	1.5	=	2.334	x	261	=	609.174
		1.556	x	1.4	=	2.1784	x	195	=	424.788
		1.556	x	2.7	=	4.2012	x	198	=	831.8376
		1.556	x	2.5	=	3.89	x	176	=	684.64
	YB2	4.890	x	2.8	=	13.692	x	58	=	794.136
	YB3	10.67	x	5.1	=	54.417	x	30	=	16869.27
		10.67	x	4.9	=	52.283	x	112	=	5855.696
		10.67	x	4.1	=	43.747	x	99	=	4330.953

Total Earned Man Hours for these Variables 36,975.065

2929 Earned Hours by WMSN X 12 = 35,148 earned man hours/year

$\frac{36975}{35148}$ = 1.05% of Total Earned Man Hours for 1.02% of the available OB bed days

The variable nursing hours exceeded total earned hours; thus, the variable earned nursing hours will be used as the base.

Lower Limit 31,211.30 (84% of variable earned man hours)
Upper Limit 36,975.06 (100% of variable earned man hours)

3B Actual hours worked $\frac{31,071}{12}$ = 2,589.25 Man Hours/Month

$\frac{\text{Actual Hours}}{\text{Earned Hours}} \quad \frac{31,071}{36,975.065}$ = 84.03%

Lower Limit (31,211.30 x 84.03%) = 26,226.86 Nursing Man Hours
Upper Limit (36,975065 x 84.03%) = 31,070.15 Nursing Man Hours

DEPT	VARIABLE	WORKLOAD FACTOR	LENGTH OF STAY	# DISP
ORTHOPEDICS	Y71	1.541 x 3.2 =	4.9312 x 116 =	572.0192
	Y72	4.843 x 2.7 =	13.0761 x 139 =	1817.5779
		4.843 x 3.6 =	17.4348 x 153 =	2667.5244
	Y73	10.57 x 5.5 =	58.135 x 179 =	10406.165
		10.57 x 4.8 =	50.736 x 217 =	11009.712
		10.57 x 3.1 =	32.767 x 136 =	4456.312
		10.57 x 4.6 =	48.622 x 63 =	3063.186
		10.57 x 3.4 =	35.938 x 343 =	12326.734
		10.57 x 4.1 =	43.337 x 56 =	2426.872
		10.57 x 7.3 =	77.161 x 290 =	22376.69

Total Earned Man hours for these variables 71,122.793

6A 4113 Earned Man Hours by WMSN
6B 1606 Earned Man Hours by WMSN

5719 Earned Man Hrs/month x 12 = 68,634 earned Man Hrs/year

$\frac{71,122.793}{68,634}$ = 1.04% of total Earned Man Hours for 43% available orthopedic bed days.

The variable nursing hours exceed the total earned hours; thus, the total variable hours will be used as the base.

Lower Limit = 56,765.91 (79.81% of earned man hours)
Upper Limit = 71,122.793 (100% of earned man hours)

6A Total actual hours worked by MEPRS $\frac{35,320}{12}$ = 2943.33/ month

6B Total actual worked by MEPRS

$$\frac{29,269}{12} = \frac{2439.08}{2} = 1219.54 \times 12 = 14,634.48$$

6A 35,320
6B 14,634.48
49,954.48

$\frac{49,954.48}{71,122.793}$ = 70.24%

$\frac{49,954.48}{71,122.793}$ = 70.24%

Lower Limit (56,765.91 x 70.24%) = 39,870.64 Nursing Man Hours.
Upper Limit (71,122.793 x 70.24%) = 49,954.57 Nursing Man Hours.

APPENDIX D

COMPUTER MODEL CONSTRAINTS, RESULTS, AND SENSITIVITY ANALYSIS

```
C O M P U T E R   M O D E L S   F O R   M A N A G E M E N T   S C I E N C E

LINEAR PROGRAMMING                                     07-26-1988 - 17:49:15

                      -=*=-  INFORMATION ENTERED  -=*=-

     NUMBER OF VARIABLES                    :   48
     NUMBER OF <= CONSTRAINTS               :   15
     NUMBER OF  = CONSTRAINTS               :    0
     NUMBER OF >= CONSTRAINTS               :   35

MIN  =          1701   X13+ 1687   X22+ 1112   X31+ 1202   X41+ 1459   X42
              + 1545   X52+ 1957   X53+  794   X61+ 1326   X62+ 1154   X71
              + 1605   X72+ 1795   X73+ 1815   X83+ 1396   X92+ 1026   XA1
              + 1664   XA2+ 2376   XA3+  904   XB1+ 1627   XB2+ 2254   XB3
              +  998   XC1+ 1296   XC2+  828   XD1+ 4069   XD3+  700   Y13
              +  869   Y22+  875   Y31+  933   Y41+ 1071   Y42+ 1428   Y52
              + 1763   Y53+  642   Y61+ 1158   Y62+  805   Y71+  792   Y72
              + 1599   Y73+ 1428   Y83+ 1092   Y92+  950   YA1+ 1283   YA2
              + 2708   YA3+  655   YB1+  834   YB2+ 1280   YB3+  807   YC1
              + 1092   YC2+  420   YD1+ 3014   YD3

SUBJECT TO:

     0     X13+    0     X22+    0     X31+    0     X41+    0     X42
+    0     X52+    0     X53+    0     X61+    0     X62+    0     X71
+    0     X72+    0     X73+    0     X83+    0     X92+    0     XA1
+    0     XA2+    0     XA3+    0     XB1+    0     XB2+    0     XB3
+    0     XC1+    0     XC2+    0     XD1+    0     XD3+    0     Y13
+    0     Y22+    2.3   Y31+    2.7   Y41+    3.1   Y42+    0     Y52
+    0     Y53+    2.4   Y61+    0     Y62+    0     Y71+    0     Y72
+    0     Y73+    0     Y83+    0     Y92+    0     YA1+    0     YA2
+    0     YA3+    0     YB1+    0     YB2+    0     YB3+    2.9   YC1
+    0     YC2+    0     YD1+    0     YD3                        <=     1883.4

     0     X13+    0     X22+    0     X31+    0     X41+    0     X42
+    0     X52+    0     X53+    0     X61+    0     X62+    0     X71
+    0     X72+    0     X73+    0     X83+    0     X92+    0     XA1
+    0     XA2+    0     XA3+    0     XB1+    0     XB2+    0     XB3
+    0     XC1+    0     XC2+    0     XD1+    0     XD3+    0     Y13
+    0     Y22+    0     Y31+    0     Y41+    0     Y42+    0     Y52
+    0     Y53+    0     Y61+    0     Y62+    3.2   Y71+    3.2   Y72
+    4.7   Y73+    0     Y83+    0     Y92+    0     YA1+    0     YA2
+    0     YA3+    0     YB1+    0     YB2+    0     YB3+    0     YC1
+    0     YC2+    0     YD1+    0     YD3                        <=     9285.6

     0     X13+    0     X22+    0     X31+    0     X41+    0     X42
+    0     X52+    0     X53+    0     X61+    0     X62+    0     X71
+    0     X72+    0     X73+    0     X83+    0     X92+    0     XA1
+    0     XA2+    0     XA3+    0     XB1+    0     XB2+    0     XB3
+    0     XC1+    0     XC2+    0     XD1+    0     XD3+    0     Y13
+    0     Y22+    0     Y31+    0     Y41+    0     Y42+    0     Y52
+    0     Y53+    0     Y61+    0     Y62+    0     Y71+    0     Y72
+    0     Y73+    0     Y83+    0     Y92+    0     YA1+    0     YA2
+    0     YA3+    2.9   YB1+    2.8   YB2+    4.7   YB3+    0     YC1
+    0     YC2+    0     YD1+    0     YD3                        <=     8395
```

```
4      0   X13+  0   X22+  0   X31+  0   X41+  0   X42
  +    0   X52+  0   X53+  0   X61+  0   X62+  0   X71
  +    0   X72+  0   X73+  0   X83+  0   X92+  0   XA1
  +    0   XA2+  0   XA3+  0   XB1+  0   XB2+  0   XB3
  +    0   XC1+  0   XC2+  0   XD1+  0   XD3+  2.5 Y13
  +    0   Y22+  0   Y31+  0   Y41+  0   Y42+  3.4 Y52
  +    4.2 Y53+  0   Y61+  2.8 Y62+  0   Y71+  0   Y72
  +    0   Y73+  5.1 Y83+  0   Y92+  0   YA1+  0   YA2
  +    0   YA3+  0   YB1+  0   YB2+  0   YB3+  0   YC1
  +    3.9 YC2+  1.5 YD1+  0   YD3                        <=   3293

5      0   X13+  0   X22+  0   X31+  0   X41+  0   X42
  +    0   X52+  0   X53+  0   X61+  0   X62+  0   X71
  +    0   X72+  0   X73+  0   X83+  0   X92+  0   XA1
  +    0   XA2+  0   XA3+  0   XB1+  0   XB2+  0   XB3
  +    0   XC1+  0   XC2+  0   XD1+  0   XD3+  0   Y13
  +    2.5 Y22+  3   Y31+  0   Y41+  0   Y42+  0   Y52
  +    0   Y53+  0   Y61+  0   Y62+  0   Y71+  0   Y72
  +    0   Y73+  0   Y83+  0   Y92+  0   YA1+  0   YA2
  +    0   YA3+  0   YB1+  0   YB2+  0   YB3+  0   YC1
  +    0   YC2+  0   YD1+  0   YD3                        <=    792

6      0   X13+  0   X22+  0   X31+  0   X41+  0   X42
  +    0   X52+  0   X53+  0   X61+  0   X62+  0   X71
  +    0   X72+  0   X73+  0   X83+  0   X92+  0   XA1
  +    0   XA2+  0   XA3+  0   XB1+  0   XB2+  0   XB3
  +    0   XC1+  0   XC2+  0   XD1+  0   XD3+  0   Y13
  +    0   Y22+  2.3 Y31+  2.7 Y41+  3.1 Y42+  0   Y52
  +    0   Y53+  2.4 Y61+  0   Y62+  0   Y71+  0   Y72
  +    0   Y73+  0   Y83+  0   Y92+  0   YA1+  0   YA2
  +    0   YA3+  0   YB1+  0   YB2+  0   YB3+  2.9 YC1
  +    0   YC2+  0   YD1+  0   YD3                        <=   2541

7      0   X13+  0   X22+  0   X31+  0   X41+  0   X42
  +    0   X52+  0   X53+  0   X61+  0   X62+  0   X71
  +    0   X72+  0   X73+  0   X83+  0   X92+  0   XA1
  +    0   XA2+  0   XA3+  0   XB1+  0   XB2+  0   XB3
  +    0   XC1+  0   XC2+  0   XD1+  0   XD3+  0   Y13
  +    0   Y22+  0   Y31+  0   Y41+  0   Y42+  0   Y52
  +    0   Y53+  0   Y61+  5.2 Y62+  0   Y71+  0   Y72
  +    0   Y73+  0   Y83+  3.2 Y92+  2   YA1+  2.7 YA2
  +    5.7 YA3+  0   YB1+  0   YB2+  0   YB3+  0   YC1
  +    0   YC2+  0   YD1+  10  YD3                        <=   3448

8      0   X13+  0   X22+  0   X31+  0   X41+  0   X42
  +    0   X52+  0   X53+  0   X61+  0   X62+  0   X71
  +    0   X72+  0   X73+  0   X83+  0   X92+  0   XA1
  +    0   XA2+  0   XA3+  0   XB1+  0   XB2+  0   XB3
  +    0   XC1+  0   XC2+  0   XD1+  0   XD3+  0   Y13
  +    0   Y22+  0   Y31+  0   Y41+  0   Y42+  0   Y52
  +    0   Y53+  0   Y61+  0   Y62+  3.2 Y71+  3.2 Y72
  +    4.7 Y73+  0   Y83+  0   Y92+  0   YA1+  0   YA2
  +    0   YA3+  0   YB1+  0   YB2+  0   YB3+  0   YC1
  +    0   YC2+  0   YD1+  0   YD3                        <=   6510

9      0   X13+  0   X22+  0   X31+  0   X41+  0   X42
  +    0   X52+  0   X53+  0   X61+  0   X62+  0   X71
  +    0   X72+  0   X73+  0   X83+  0   X92+  0   XA1
  +    0   XA2+  0   XA3+  0   XB1+  0   XB2+  0   XB3
  +    0   XC1+  0   XC2+  0   XD1+  0   XD3+  0   Y13
  +    0   Y22+  0   Y31+  0   Y41+  0   Y42+  0   Y52
  +    0   Y53+  0   Y61+  0   Y62+  0   Y71+  0   Y72
  +    0   Y73+  0   Y83+  0   Y92+  0   YA1+  0   YA2
  +    0   YA3+  2.9 YB1+  2.8 YB2+  4.7 YB3+  0   YC1
  +    0   YC2+  0   YD1+  0   YD3                        <=   6956
```

10		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	26.425	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	16.468	Y52		
	+	44.394	Y53+	0	Y61+	13.552	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	53.907	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	18.888	YC2+	2.312	YD1+	0	YD3					<=	21373.359
11		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	12.108	Y22+	4.544	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					<=	3024.95
12		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	3.475	Y31+	4.08	Y41+	14.722	Y42+	0	Y52		
	+	0	Y53+	3.626	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	4.38	YC1		
	+	0	YC2+	0	YD1+	0	YD3					<=	3424.77
13		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	13.506	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	15.498	Y92+	3.082	YA1+	13.076	YA2		
	+	60.249	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	105.7	YD3					<=	34741.449
14		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	4.931	Y71+	15.255	Y72		
	+	49.528	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					<=	49954.5
15		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	3.423	YB1+	13.692	YB2+	50.15	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					<=	31071

16		2.6	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	2.4	X52+	3	X53+	0	X61+	2.5	X62+	0	X71		
	+	0	X72+	0	X73+	4.5	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	3	XC2+	2	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	3000
17		0	X13+	1.7	X22+	1.8	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	175
18		0	X13+	0	X22+	1.8	X31+	2.9	X41+	3.6	X42		
	+	0	X52+	0	X53+	2.4	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	2.8	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	2400
19		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	2.5	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	1.9	X92+	2.2	XA1		
	+	2.3	XA2+	4.8	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	4.7	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	1750
20		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	2.7	X71		
	+	1.9	X72+	3.1	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	900
21		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	2.1	XB1+	2.8	XB2+	4.5	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	6000

22		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	2.5	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	3.4	Y52		
	+	4.2	Y53+	0	Y61+	2.8	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	5.1	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	3.9	YC2+	1.5	YD1+	0	YD3					>=	2282
23		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	2.5	Y22+	3	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	521.95
24		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	2.3	Y31+	2.7	Y41+	3.1	Y42+	0	Y52		
	+	0	Y53+	2.4	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	2.9	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	1007.4
25		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	5.2	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	3.2	Y92+	2	YA1+	2.7	YA2		
	+	5.7	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	10	YD3					>=	1124
26		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	3.2	Y71+	3.2	Y72		
	+	4.7	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	5781.6
27		0	X13+	0	X22+	0	X31+	0	X41+	0	X42		
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71		
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1		
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3		
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13		
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52		
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72		
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2		
	+	0	YA3+	2.9	YB1+	2.8	YB2+	4.7	YB3+	0	YC1		
	+	0	YC2+	0	YD1+	0	YD3					>=	6883.9

28		2.6	X13+	1.7	X22+	1.8	X31+	2.9	X41+	3.6	X42	
	+	2.4	X52+	3	X53+	2.4	X61+	2.5	X62+	2.7	X71	
	+	1.9	X72+	3.1	X73+	4.5	X83+	1.9	X92+	2.2	XA1	
	+	2.3	XA2+	4.8	XA3+	2.1	XB1+	2.8	XB2+	4.5	XB3	
	+	2.8	XC1+	3	XC2+	2	XD1+	4.7	XD3+	0	Y13	
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52	
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72	
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2	
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1	
	+	0	YC2+	0	YD1+	0	YD3				>=	13800
29		0	X13+	0	X22+	0	X31+	0	X41+	0	X42	
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71	
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1	
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3	
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	2.5	Y13	
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52	
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72	
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2	
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1	
	+	0	YC2+	0	YD1+	0	YD3				>=	150
30		0	X13+	0	X22+	0	X31+	0	X41+	0	X42	
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71	
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1	
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3	
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13	
	+	2.5	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52	
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72	
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2	
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1	
	+	0	YC2+	0	YD1+	0	YD3				>=	250
31		0	X13+	0	X22+	0	X31+	0	X41+	0	X42	
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71	
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1	
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3	
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13	
	+	0	Y22+	2.7	Y31+	0	Y41+	0	Y42+	0	Y52	
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72	
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2	
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1	
	+	0	YC2+	0	YD1+	0	YD3				>=	300
32		0	X13+	0	X22+	0	X31+	0	X41+	0	X42	
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71	
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1	
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3	
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13	
	+	0	Y22+	0	Y31+	2.7	Y41+	0	Y42+	0	Y52	
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72	
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2	
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1	
	+	0	YC2+	0	YD1+	0	YD3				>=	200
33		0	X13+	0	X22+	0	X31+	0	X41+	0	X42	
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71	
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1	
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3	
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13	
	+	0	Y22+	0	Y31+	0	Y41+	3.1	Y42+	0	Y52	
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72	
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2	
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1	
	+	0	YC2+	0	YD1+	0	YD3				>=	250

34 0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
+ 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
+ 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
+ 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
+ 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
+ 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 3.4 Y52
+ 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
+ 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
+ 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
+ 0 YC2+ 0 YD1+ 0 YD3
>= 300

35 0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
+ 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
+ 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
+ 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
+ 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
+ 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
+ 4.2 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
+ 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
+ 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
+ 0 YC2+ 0 YD1+ 0 YD3
>= 250

36 0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
+ 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
+ 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
+ 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
+ 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
+ 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
+ 0 Y53+ 2.4 Y61+ 0 Y62+ 0 Y71+ 0 Y72
+ 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
+ 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
+ 0 YC2+ 0 YD1+ 0 YD3
>= 200

37 0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
+ 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
+ 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
+ 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
+ 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
+ 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
+ 0 Y53+ 0 Y61+ 4 Y62+ 0 Y71+ 0 Y72
+ 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
+ 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
+ 0 YC2+ 0 YD1+ 0 YD3
>= 500

38 0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
+ 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
+ 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
+ 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
+ 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
+ 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
+ 0 Y53+ 0 Y61+ 0 Y62+ 3.2 Y71+ 0 Y72
+ 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
+ 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
+ 0 YC2+ 0 YD1+ 0 YD3
>= 350

39 0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
+ 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
+ 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
+ 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
+ 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
+ 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
+ 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
+ 4.7 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
+ 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
+ 0 YC2+ 0 YD1+ 0 YD3
>= 3300

```
40      0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
      + 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
      + 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
      + 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
      + 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
      + 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
      + 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
      + 0 Y73+ 5.1 Y83+ 0 Y92+ 0 YA1+ 0 YA2
      + 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
      + 0 YC2+ 0 YD1+ 0 YD3                  >=   500
41      0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
      + 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
      + 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
      + 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
      + 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
      + 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
      + 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
      + 0 Y73+ 0 Y83+ 3.2 Y92+ 0 YA1+ 0 YA2
      + 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
      + 0 YC2+ 0 YD1+ 0 YD3                  >=   150
42      0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
      + 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
      + 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
      + 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
      + 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
      + 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
      + 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
      + 0 Y73+ 0 Y83+ 0 Y92+ 2 YA1+ 0 YA2
      + 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
      + 0 YC2+ 0 YD1+ 0 YD3                  >=   100
43      0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
      + 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
      + 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
      + 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
      + 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
      + 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
      + 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
      + 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 2.7 YA2
      + 0 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
      + 0 YC2+ 0 YD1+ 0 YD3                  >=   150
44      0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
      + 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
      + 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
      + 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
      + 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
      + 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
      + 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
      + 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
      + 5.7 YA3+ 0 YB1+ 0 YB2+ 0 YB3+ 0 YC1
      + 0 YC2+ 0 YD1+ 0 YD3                  >=   300
45      0 X13+ 0 X22+ 0 X31+ 0 X41+ 0 X42
      + 0 X52+ 0 X53+ 0 X61+ 0 X62+ 0 X71
      + 0 X72+ 0 X73+ 0 X83+ 0 X92+ 0 XA1
      + 0 XA2+ 0 XA3+ 0 XB1+ 0 XB2+ 0 XB3
      + 0 XC1+ 0 XC2+ 0 XD1+ 0 XD3+ 0 Y13
      + 0 Y22+ 0 Y31+ 0 Y41+ 0 Y42+ 0 Y52
      + 0 Y53+ 0 Y61+ 0 Y62+ 0 Y71+ 0 Y72
      + 0 Y73+ 0 Y83+ 0 Y92+ 0 YA1+ 0 YA2
      + 0 YA3+ 0 YB1+ 2.8 YB2+ 0 YB3+ 0 YC1
      + 0 YC2+ 0 YD1+ 0 YD3                  >=   130
```

46		0	X13+	0	X22+	0	X31+	0	X41+	0	X42
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2
	+	0	YA3+	0	YB1+	0	YB2+	4.7	YB3+	0	YC1
	+	0	YC2+	0	YD1+	0	YD3				
										>=	1500
47		0	X13+	0	X22+	0	X31+	0	X41+	0	X42
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	2.9	YC1
	+	0	YC2+	0	YD1+	0	YD3				
										>=	300
48		0	X13+	0	X22+	0	X31+	0	X41+	0	X42
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1
	+	0	YC2+	1.5	YD1+	0	YD3				
										>=	400
49		0	X13+	0	X22+	0	X31+	0	X41+	0	X42
	+	0	X52+	0	X53+	0	X61+	0	X62+	0	X71
	+	0	X72+	0	X73+	0	X83+	0	X92+	0	XA1
	+	0	XA2+	0	XA3+	0	XB1+	0	XB2+	0	XB3
	+	0	XC1+	0	XC2+	0	XD1+	0	XD3+	0	Y13
	+	0	Y22+	0	Y31+	0	Y41+	0	Y42+	0	Y52
	+	0	Y53+	0	Y61+	0	Y62+	0	Y71+	0	Y72
	+	0	Y73+	0	Y83+	0	Y92+	0	YA1+	0	YA2
	+	0	YA3+	0	YB1+	0	YB2+	0	YB3+	0	YC1
	+	0	YC2+	0	YD1+	10	YD3				
										>=	1000
50		2.6	X13+	1.7	X22+	1.8	X31+	2.9	X41+	3.6	X42
	+	2.4	X52+	3	X53+	2.4	X61+	2.5	X62+	2.7	X71
	+	1.9	X72+	3.1	X73+	4.5	X83+	1.9	X92+	2.2	XA1
	+	2.3	XA2+	4.8	XA3+	2.1	XB1+	2.8	XB2+	4.5	XB3
	+	2.8	XC1+	3	XC2+	2	XD1+	4.7	XD3+	2.5	Y13
	+	2.5	Y22+	2.7	Y31+	2.7	Y41+	3.1	Y42+	3.4	Y52
	+	4.2	Y53+	2.4	Y61+	4	Y62+	3.2	Y71+	3.2	Y72
	+	4.7	Y73+	5.1	Y83+	3.2	Y92+	2	YA1+	2.7	YA2
	+	5.7	YA3+	2.9	YB1+	2.8	YB2+	4.7	YB3+	2.9	YC1
	+	3.9	YC2+	1.5	YD1+	10	YD3				
										>=	40888

-=*=- RESULTS -=*=-

VARIABLE	VARIABLE VALUE	ORIGINAL COEFFICIENT	COEFFICIENT SENSITIVITY
X13	0	1701	652.333
X22	0	1687	636.778
X31	97.222	1112	0
X41	0	1202	242.583
X42	0	1459	268
X52	0	1545	577
X53	0	1957	747
X61	3783.551	794	0
X62	700	1326	0
X71	333.333	1154	0
X72	0	1605	792.926
X73	0	1795	470.037
X83	277.778	1815	0
X92	0	1396	525.99
XA1	0	1026	18.62
XA2	0	1664	610.83
XA3	0	2376	178.08
XB1	2857.143	904	0
XB2	0	1627	421.667
XB3	0	2254	316.857
XC1	0	998	71.667
XC2	0	1296	86
XD1	0	828	21.333
XD3	0	4069	1916.87
Y13	60	700	0
Y22	100	869	0
Y31	111.111	875	0
Y41	74.074	933	0
Y42	80.645	1071	0
Y52	88.235	1428	0
Y53	59.524	1763	0
Y61	302.282	642	0
Y62	125	1158	0
Y71	109.375	805	0
Y72	893.75	792	0
Y73	702.128	1599	0
Y83	98.039	1428	0
Y92	46.875	1092	0
YA1	50	950	0
YA2	55.556	1283	0
YA3	52.632	2708	0
YB1	1836.552	655	0
YB2	46.429	834	0
YB3	319.149	1280	0
YC1	103.448	807	0
YC2	344.359	1092	0
YD1	266.667	420	0
YD3	209.8	3014	0

-- SENSITIVITY ANALYSIS --

OBJECTIVE FUNCTION COEFFICIENTS

VARIABLE	LOWER LIMIT	ORIGINAL COEFFICIENT	UPPER LIMIT
X13	1048.667	1701	NO LIMIT
X22	1050.222	1687	NO LIMIT
X31	595.5	1112	1786.235
X41	959.417	1202	NO LIMIT
X42	1191	1459	NO LIMIT
X52	968	1545	NO LIMIT
X53	1210	1957	NO LIMIT
X61	723.36	794	814.313
X62	1008.333	1326	1347.159
X71	893.25	1154	1563.387
X72	812.074	1605	NO LIMIT
X73	1324.963	1795	NO LIMIT
X83	1776.914	1815	1863
X92	870.01	1396	NO LIMIT
XA1	1007.38	1026	NO LIMIT
XA2	1053.17	1664	NO LIMIT
XA3	2197.92	2376	NO LIMIT
XB1	694.75	904	1051.867
XB2	1205.333	1627	NO LIMIT
XB3	1937.143	2254	NO LIMIT
XC1	926.333	998	NO LIMIT
XC2	1210	1296	NO LIMIT
XD1	806.667	828	NO LIMIT
XD3	2152.13	4069	NO LIMIT
Y13	700	700	NO LIMIT
Y22	827.083	869	NO LIMIT
Y31	747.58	875	NO LIMIT
Y41	722.219	933	NO LIMIT
Y42	408.445	1071	NO LIMIT
Y52	952	1428	NO LIMIT
Y53	1176	1763	NO LIMIT
Y61	NO LIMIT	642	667.821
Y62	1027.947	1158	NO LIMIT
Y71	792	805	NO LIMIT
Y72	NO LIMIT	792	805
Y73	1163.25	1599	NO LIMIT
Y83	1428	1428	NO LIMIT
Y92	964.48	1092	NO LIMIT
YA1	602.8	950	NO LIMIT
YA2	813.78	1283	NO LIMIT
YA3	1717.98	2708	NO LIMIT
YB1	NO LIMIT	655	789.787
YB2	632.414	834	NO LIMIT
YB3	1061.552	1280	NO LIMIT
YC1	775.809	807	NO LIMIT
YC2	NO LIMIT	1092	1092
YD1	420	420	NO LIMIT
YD3	NO LIMIT	3014	3264.103

CONSTRAINT NUMBER	ORIGINAL RIGHT-HAND VALUE	SLACK OR SURPLUS	SHADOW PRICE
1	1883.4	152.367	0
2	9285.6	2775.6	0
3	8395	1439	0
4	3293	0	50.833
5	792	208.667	0
6	2541	809.967	0
7	3448	0	29.433
8	6510	0	83.333
9	6956	0	104.971
10	21373.359	1592.514	0
11	3024.95	1309.261	0
12	3424.77	0	41.919
13	34741.449	6099.325	0
14	49954.5	1006.035	0
15	31071	8143.463	0
16	3000	0	72.5
17	175	0	286.944
18	2400	6855.523	0
19	1750	0	127.067
20	900	0	96.574
21	6000	0	99.643
22	2282	1011	0
23	521.95	61.383	0
24	1007.4	723.633	0
25	1124	2324	0
26	5781.6	728.4	0
27	6883.9	72.101	0
28	13800	5355.523	0
29	150	0	0
30	250	0	16.767
31	300	0	47.193
32	200	0	78.067
33	250	0	213.727
34	300	0	140
35	250	0	139.762
36	200	525.477	0
37	500	0	32.513
38	350	0	4.063
39	3300	0	92.713
40	500	0	0
41	150	0	39.85
42	100	0	173.6
43	150	0	173.785
44	300	0	173.688
45	130	0	71.995
46	1500	0	46.478
47	300	0	10.755
48	400	0	0
49	1000	1098	0
50	40888	0	330.833

OBJECTIVE FUNCTION VALUE: 13688624

RIGHT-HAND-SIDE VALUES

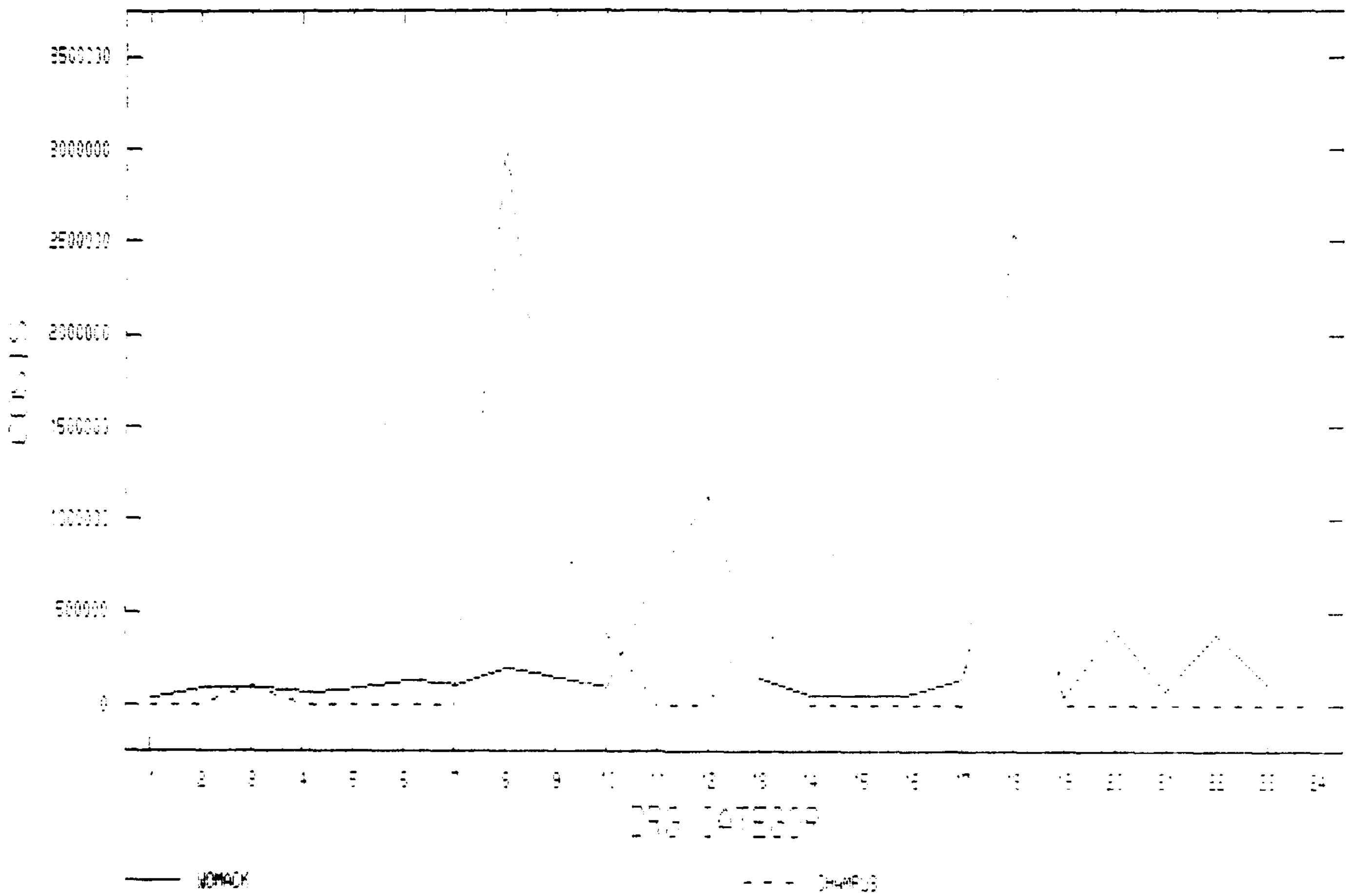
CONSTRAINT NUMBER	LOWER LIMIT	ORIGINAL VALUE	UPPER LIMIT
1	1731.033	1883.4	NO LIMIT
2	6510	9285.6	NO LIMIT
3	6956	8395	NO LIMIT
4	2282	3293	3621.823
5	583.333	792	NO LIMIT
6	1731.033	2541	NO LIMIT
7	2350	3448	4025.041
8	5781.6	6510	6721.033
9	6883.899	6956	8395
10	19780.846	21373.359	NO LIMIT
11	1715.689	3024.95	NO LIMIT
12	2630.861	3424.77	3654.971
13	28642.125	34741.449	NO LIMIT
14	48948.465	49954.5	NO LIMIT
15	22927.537	31071	NO LIMIT
16	1750.001	3000	9855.523
17	- 0	175	9255.524
18	NO LIMIT	2400	9255.523
19	- 0	1750	2999.999
20	- 0	900	7755.523
21	0	6000	12855.523
22	NO LIMIT	2282	3293
23	NO LIMIT	521.95	583.333
24	NO LIMIT	1007.4	1731.033
25	NO LIMIT	1124	3448
26	NO LIMIT	5781.6	6510
27	NO LIMIT	6883.9	6956
28	NO LIMIT	13800	19155.523
29	0	150	428.075
30	188.617	250	458.667
31	244.755	300	487.8
32	0	200	725.381
33	178.911	250	417.173
34	0	300	1643
35	0	250	528.075
36	NO LIMIT	200	725.477
37	0	500	1344.615
38	38.172	350	3210
39	0	3300	3474.335
40	0	500	778.075
41	0	150	1248
42	0	100	1198
43	0	150	1248
44	0	300	1398
45	0	130	2325.207
46	- 0	1500	2358.122
47	0	300	825.647
48	- 0	400	1743
49	NO LIMIT	1000	2098
50	35532.477	40888	NO LIMIT

APPENDIX E

ANALYSIS OF RESULTS - CHAMPUS AND WOMACK COSTS - GRAPHIC ILLUSTRATION

APPENDIX E

ANALYSIS OF RESULTS: CHAMPUS AND WOMACK COSTS



1 = 13	7 = 53	13 = 83	19 = B2
2 = 22	8 = 61	14 = 92	20 = B3
3 = 31	9 = 62	15 = A1	21 = C1
4 = 41	10 = 71	16 = A2	22 = C2
5 = 42	11 = 72	17 = A3	23 = D1
6 = 52	12 = 73	18 = B1	24 = D3

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